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ABSTRACT

To identify problems regarding economic development, the Committee for Scientific and Technical Personnel conducted an educational and occupational survey of each member country of the Organisation for Economic Cooperation and Development (OECD). The specific purpose of the surveys was to gather comparative data on the training and utilization of technicians in each member country. Major sections of each survey are: (1) The Structure of the Educational System, (2) Training of Technicians and Other Technical Manpower, and (3) Functions of Technicians. Related surveys for each of the following countries, Canada, Denmark, Spain, France, Netherlands, Switzerland, Yugoslavia, Portugal, and Italy, are available in this issue as VT 015 716-VT 015 722, and VT 015 724-VT 015 725 respectively. (JS)

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SCIENTIFIC AND TECHNICAL PERSONNEL

THE EDUCATION, TRAINING AND FUNCTIONS OF TECHNICIANS

UNITED KINGDOM

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DIRECTORATE FOR SCIENTIFIC AFFAIRS
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

SCIENTIFIC AND TECHNICAL PERSONNEL

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THE EDUCATION, TRAINING AND FUNCTIONS OF TECHNICIANS

UNITED KINGDOM

DIRECTORATE FOR SCIENTIFIC AFFAIRS

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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The Organisation for Economic Co-operation and Development was set up under a Convention signed in Paris on 14th December 1960 by the Member countries of the Organisation for European Economic Co-operation and by Canada and the United States. This Convention provides that the O.E.C.D. shall promote policies designed:

- *to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the world economy;*
- *to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development;*
- *to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.*

The legal personality possessed by the Organisation for European Economic Co-operation continues in the O.E.C.D. which came into being on 30th September 1961.

The members of O.E.C.D. are Austria, Belgium, Canada, Denmark, France, the Federal Republic of Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

The Directorate for Scientific Affairs, which is responsible for the publication of the present report, has been established within O.E.C.D. to take charge of the activities of the Organisation relating to scientific research and to the expansion and rational utilisation of the scientific and technical personnel available so as to meet the needs arising from economic growth.

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PREFACE

The O.E.C.D. Committee for Scientific and Technical Personnel has given considerable attention to the technician problem as a key issue in the economic development of Member countries and has on several occasions drawn attention to the need for an adequate supply and proper training for skills at this level.

To help elucidate some of the aspects arising from this problem the Committee initiated a number of surveys analysing the situation in several Member countries and on the basis of which the exchange of experience between them could be more constructive and mutually profitable.

These surveys, as they are completed, are used as basic working documents for confrontation meetings between two or more countries, in which, under neutral chairmanship, teams from countries under examination discuss together their problems and training systems and try to draw conclusions, both on questions of policy and on technical aspects.

The present publication, the first of a series, was prepared by Mr. G. Sutton, consultant to the Directorate for Scientific Affairs of O.E.C.D., after the confrontation meeting between France and the United Kingdom. It incorporates information already available in previous O.E.C.D. surveys, namely "Education and training of engineers of non-university level and technicians in the United Kingdom", which was carried out by a joint F.E.A.N.I./E.U.S.E.C.(1), Committee, and "Enquiry into the function of technicians in industry in the United Kingdom", as well as supplementary information collected as a result of investigations in the country itself.

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(1) European Federation of National Associations of Engineers (FEANI) Conference of Engineering Societies of Western Europe and the United States of America (EUSEC).

Chapter I

THE EDUCATIONAL SYSTEM FOR TECHNICIANS

A. THE GENERAL SYSTEM OF EDUCATION

The education of engineering and other technicians in the United Kingdom is naturally based on their previous education, part of the general system of education outlined in this Chapter. To survey this general system it is probably better to deal first with its administration and control, since these are much less rigid than in most other countries yet determine to a large extent the general pattern of education and the facilities provided for it.

B. THE STAGES OF EDUCATION

There are three main stages of education, the first two being compulsory and the third optional. They are primary, secondary and further or higher education.

Primary education begins at five years of age and the transition to secondary education is made between 10 1/2 and 12 years, 11 being the normal transfer age. The minimum school leaving age, from secondary school, is 15 but from 1970-71 will be 16. Many pupils stay on at school until the age of 18.

On leaving school, pupils may decide to follow a course in further education at a technical college, college of art or similar institution, generally selecting a vocational course to suit their actual or prospective employment.

Pupils who have gained the necessary entry qualifications may decide to enter a university and study for a first degree. Alternatively, they may go to a college of advanced technology (see Chapter I, D.6 (b)), or to one of a number of technical colleges or similar institutions approved to offer degree or equivalent courses.

C. ADMINISTRATION AND CONTROL OF THE GENERAL SYSTEM OF EDUCATION

1. The Department of Education and Science

The central authority for education in England and Wales is the Department of Education and Science. Scotland and Northern Ireland have their own departments and administrations but their systems of education are not widely different from that of England and Wales.

The Education Act of 1944 made it the duty of the Minister of Education "..... to promote the education of the people of England and Wales and the progressive development of institutions devoted to that purpose, and to secure the effective execution by local authorities, under his control and direction, of the national policy for providing varied and comprehensive educational service in every area."

Since 1st. April, 1964, when the Ministry of Education became the Department of Education and Science, these duties have been transferred to the Secretary of Education and Science, the political head of the Department, who is a member of the Government of the day and is assisted by two Ministers of State and two Parliamentary Under-Secretaries. The Department is staffed by civil servants whose appointments are not dependent on political considerations. Their work is organised in two administrative units under the two Ministers of State; one concerned with schools, further education, teachers and kindred subjects; the other with universities and with civil science. Specialist branches for health, buildings, statistics, law and information are available to provide professional advice for both administrative units.

2. The Departmental Branches for Schools, Teachers and Further Education

(a) The Department does not run any schools, technical colleges, colleges of art or similar institutions, it does not engage any teachers, prescribe any curricula, syllabuses or textbooks, nor set any examinations, but it has the following responsibilities.

(i) It sets minimum standards of educational provision in schools and colleges;

(ii) It controls the amount of educational building in each section (primary, secondary, further and higher) and the distribution of this building throughout the country;

(iii) It controls the training and supply of teachers for compulsory primary and secondary education;

(iv) It administers a superannuation scheme for all teachers except those in universities and independent schools;

(v) It arranges for the annual financial estimates of the local education authorities (see para.3) to be incorporated in the general grant made annually to local authorities from central (national) funds;

(vi) It supports financially by direct grant a limited number of institutions, such as the direct-grant schools and certain specialist colleges.

(b) Guidance and control by local authorities and schools are exercised by means of regulations, orders and circular letters, and by pamphlets and handbooks. Two Central Advisory Councils of Education (one for England and the other for Wales, advise the Secretary of State on matters referred to them. Discussions are held at national level with representative bodies such as local authority associations, teachers' associations, examining bodies and bodies representing religious interests. Although national policy and control in education are the responsibility of the Department, local policy and control are exercised by the 173 directly elected councils of the counties, county boroughs and London boroughs.

3. Local Authorities

(a) England and Wales are historically and geographically divided into 52 counties, excluding London, and the counties differ very widely in area and population. So much so that, for administrative purposes, four of the larger ones are divided into parts, giving a total of 58 separate units, each with its own county council.

Within the counties, many cities and towns are separately constituted as county boroughs, each with its own county borough council which has the same powers and duties as a county council. County borough status depends on a number of factors but, nowadays, a new county borough is not contituted unless its population is a minimum of 100,00. Excluding London, there are now 82 county borough councils.

The recent London Government Act (1963) has established 12 inner and 20 outer London boroughs and a Greater London Council.

(b) Each of these county, county borough and London borough councils is responsible for local government in its area, including education and, for the latter purpose, is often termed a Local Education Authority. Each council appoints a local education committee from its own members and other persons with experience in education and industry, whose duty is to provide efficient education at the three progressive levels, primary, secondary and further, to meet the needs of the local population. They build and equip their schools and colleges, appoint and pay their teachers, and are responsible for the development and administration of the local education provision, other than in universities and colleges of advanced technology. The cost of the education they provide is met mainly from rates (a local property tax) and from the general grant by government which covers about 60% of the total cost.

The local education authority has no responsibility for direct-grant or independent schools.

(c) In Scotland there are 33 county councils and four town councils, for the cities of Edinburgh, Glasgow, Aberdeen and Dundee. In Northern Ireland there are six county councils and two county borough councils, for the cities of Belfast and Londonderry.

4. Her Majesty's Inspectorate

Liaison between the local education authorities and the Department is effected largely by Her Majesty's Inspectors, of whom there are about 500 and whose primary function is to report to the Secretary of State on schools and educational establishments other than universities and colleges of advanced technology. They do not, however, report on individual teachers, either to the Department or to the local education authority. They offer advice and discuss day-to-day problems with local authorities and schools, give professional educational advice to the Department, provide a focus for educational development, conduct courses for teachers, prepare advisory pamphlets, assist examining bodies and other institutions, and act as assessors or members of regional and national committees. Speaking generally, they represent the Department "in the field" but strictly speaking they are advisers to, rather than officers of, the Department. Because of their experience and wide contacts, H.M. Inspectors exert a considerable influence in all fields of education.

5. The Departmental Branch for Universities

The Branch concerned with universities is responsible for their finance and building programmes, and deals generally with questions relating to universities, but is not answerable for the detailed allocation of funds to individual institutions, for their academic policy or their administrative procedures. Universities are in all respects autonomous bodies with complete academic freedom. They alone decide what students to admit, what professors and other academic staff to appoint, what to teach, what degrees to award and on what conditions. The Government has relations to them through the University Grants Committee, a body appointed by the Secretary of State and Consisting of members drawn from the academic and business worlds. Government grants through the University Grants Committee cover about 70 per cent of the universities' current expenditure and about 90 per cent of their capital expenditure, and their allocation to individual universities is decided by the Committee, not by Government. As the colleges of advanced technology (see chapter I D.6 (b)) are to achieve university status, the University Grants Committee now exercices responsibility towards them in the same way.

6. Examinations

The Department of Education and Science has no direct control over examinations at any stage of the educational system, although it is generally represented, mainly through the Inspectorate, on examining Councils and bodies other than those of universities and colleges of advanced technology. Details of various types of examinations, at different levels, are given as they arise in later paragraphs.

7. Thus, the whole system of education is decentralised and free of rigid control. The local education authorities set the pattern of education in each area, the universities and colleges of advanced technology are completely autonomous, and examinations are controlled by independent bodies. The Department of Education and Science does control national expenditure and policy, but the latter only through recommmandation and guidance. Such a system is extremely flexible and adaptive, permits experiment in many directions and promotes development to suit the times.

D. THE STRUCTURE OF THE GENERAL EDUCATIONAL SYSTEM

1. As stated previously, the years of compulsory schooling are from five to 15 (from 1970-71 the minimum leaving age will be 16) and the transition from primary to secondary school is made between 10 1/2 and 12 years, normally about 11 years. No fees are payable in any publicly maintained school though parents may, if they wish, pay for their children to attend independent schools, which charge fees.

The third and voluntary stage includes the universities, colleges of advanced technology, colleges of further education (including technical college and colleges of commerce), colleges of art, colleges of education (teacher training colleges), certain specialised colleges and similar institutions, for attendance at all of which financial assistance is available.

The 30,000 or so primary and secondary schools maintained by the local authorities are known as maintained schools, as distinct from the direct-grant and independent schools, which are known as non-maintained schools. Of a total school population of 7,618,500 in 1963, 7,009,200 pupils attended maintained schools.

2. Primary Schools

About half the 23,000 maintained primary schools in 1963 covered the complete age range from five to 11 years, the others being divided into infant schools and junior schools.

3. Maintained Secondary Schools

There are some 6,000 maintained secondary schools in England and Wales of various types, over half of them being co-educational schools for both sexes. The main groups are secondary modern, secondary grammar, secondary technical and secondary comprehensive.

The 4,000 secondary modern schools form the largest group, with more than 1,600,000 pupils, and provide a general education up to the minimum school leaving age of 15, though pupils can and increasingly do stay on beyond that age. Some secondary modern schools prepare the more able pupils for examinations of the General Certificate of Education (See Chapter I, D.5. (c)) and many are now preparing pupils for the new Certificate of Secondary Education examinations instituted in 1965 (see chapter I, D.5. (d)).

The 1,300 secondary grammar schools form the next largest group, with a total of some 723,000 pupils, and provide a mainly academic course for pupils remaining at school until 16 or a higher age. Many pupils stay on to the age of 18 to qualify for university entrance or other requirement and their course in the Sixth Form, from 16 to 18, generally involves some specialisation to suit their proposed degree course or other need.

The 200 secondary technical schools, with a total of some 90,000 pupils, are academic equivalents of grammar schools but offer certain specialised technical and commercial studies. Like the grammar schools, they also offer sixth form courses leading to university or professional studies.

The number of secondary comprehensive schools in 1963 was 175, with an average of over 1,000 pupils each, but their number is increasing rapidly. The comprehensive school caters for the education of all children in its area and therefore covers a wide range of pupil abilities. Some of the pupils may follow a general education with no particular bias, though they may develop to a higher level a particular interest or ability. Others may follow a course with a technical, commercial or other vocational bias at later stages, while some who are academically capable will go to the sixth form and possibly a university. Some areas have two-tier (two-stage) comprehensive schools, the second tier starting at 13 or 14 years, and there are other modifications of the comprehensive scheme.

In 1963, there were 66 bilateral and multilateral schools, with a total of 47,000 pupils. A bilateral school is one that provides any two of the three main types of secondary education in separately organised streams, i.e., modern-grammar, modern-technical or grammar-technical. A multilateral school provides all three types of education in separately organised streams.

There are also a number of special schools, e.g., for blind, deaf and physically-handicapped children.

These many variations in secondary provision owe something to tradition and development as well as local needs and preferences.

4. Non-Maintained Schools

There are some 4,200 non-maintained schools of various types, from nursery schools upwards, with a total of some 610,000 pupils, in all of which school fees are charged. Of these, in 1963, 328 schools with a total of 124,000 pupils were direct-grant schools receiving direct grant from central funds, and included 179 grammar schools with a total of over 112,000 pupils, most of which were established under religious and other voluntary agencies before the Education Act of 1944.

The remaining 3,800 independent schools, with a total of 485,000 pupils, receive no grant from public funds but some, particularly the long-established ones, are supported by voluntary agencies or are well-endowed. They include a great many local private schools, the 500 recognised Preparatory Schools and the 90 or so "Public Schools", many of which are very old foundations. The Preparatory Schools are so named because they prepare pupils for entry to the Public Schools, usually at the age of 13; the Public Schools are so named by tradition but are in fact private schools, admitting from the public but not maintained by public funds.

The direct-grant and some recognised independent schools reserve a proportion of places for pupils sent and paid for by the local authorities.

All non-maintained schools have to be officially registered and open to inspection. Some 1,500 of them, with 305,000 pupils, have reached a sufficiently high standard for recognition as efficient by the Secretary of State, following satisfactory reports by Her Majesty's Inspectors.

5. School-leaving Examinations

(a) Internal and External Examinations

In schools and colleges in the United Kingdom, there are two sorts of examinations, internal and external. An internal examination is one set and marked by the teachers within a school or college. An external examination is one set and marked by an outside, independent examining body. In some cases, for a recognised qualilification and particularly in colleges, the school or college is allowed to set and mark an internal examination but this is assessed and moderated by an external examining or other appointed body. Assessment is the prior inspection and possible modification of the question papers by the external body; moderation is the scrutiny and possible modification of the marking of the scripts (answer papers) by the same body.

Examinations in universities are always internal.

(b) Alternatives on Leaving School

At 15, pupils have a variety of options. They may leave school and discontinue formal education, or may go on to technical colleges and other institutions, attending full-time or part-time day or evening courses. They may stay at school a further year and thus be able to take an external examination or they may stay until about 18 and take a higher external examination for admission to a university, a college of advanced technology, a national, regional or other college or a college of education.

The choice between these alternatives often turns very much on what examination results can be achieved, the most common examinations being those for the General Certificate of Education (G.C.E.).

(c) The General Certificate of Education

The G.C.E. is awarded in a wide range of subjects by nine separate and independent Examining Bodies in England and Wales, and one in Northen Ireland (see Appendix 1), most of them connected with a university, and provides convenient levels of qualification for entry to further and higher education. It is also accepted by many professional bodies in lieu of their own preliminary examinations. Any of the Examining Bodies may be chosen and a candidate may take any number of subjects, these being offered at Ordinary and Advanced levels. Ordinary-level ("O" level) papers are normally taken at a minimum age of 16 years (particularly-able candidates may be accepted as special cases at an earlier age) and Advanced-level ("A" level) papers normally two years later.

Some students are content with only two or three "O" level passes but those aiming at any advanced or professional qualification usually try to obtain at least five "O" levels. For university entrance and other higher qualifications, candidates will aim for at least two and often three "A" level passes, and the more brilliant may take the Special papers at "A" level to earn a supplementary grading, viz., "Distinction" or "Merit".

The minimum qualification for entry to university normally includes two "A" level passes.

Of the 618,000 pupils who left maintained secondary schools of all types in 1964, approximately 200,000 sat for G.C.E. "O" level examinations and 91,000 passed in five or more subjects. Of 14,500 pupils leaving direct-grant schools, 13,700 sat for "O" level and 10,000 passed in five or more subjects. In the recognised independent schools of similar type, from 29,900 leavers, 27,300 pupils sat for "O" levels and 17,900 passed in five or more subjects. Thus, from a total of 667,000 school leavers of various ages, 241,000 sat for "O" level subjects and 118,900 obtained five or more passes, representing 17,9 per cent of all school leavers.

Of the same 618,000 school leavers from maintained secondary schools of all types, only 55,900 attempted "A" level examinations, and 39,500 passed in two or more subjects. In the direct-grant schools, 8,200 leavers sat "A" level examinations and 6,400 gained two or more passes. In the recognised independent schools, 12,900 sat the examinations and 8,900 gained two or more passes. Thus from a total of 662,000 school leavers of various ages, 77,000 sat for "A" levels and 54,800 obtained two or more passes, representing 8,3 per cent of all school leavers.

In considering the above figures, it must be remembered that a high proportion of the pupils at secondary modern and comprehensive schools do not attempt G.C.E. examinations, for these are intended for pupils in the higher ranges of academic ability (but see (d)).

G.C.E. examinations are in fact not restricted to school pupils but are available to private candidates or those from technical colleges or other establishments. Many technical colleges provide G.C.E. courses in certain subjects for students who find they need them but have not, for a variety of reasons, taken them while at school.

(d) The Certificate of Secondary Education

This year, 1965, a new external examination becomes available for pupils with a minimum of five years' secondary education (that is, pupils at least 16 years old) and is called the Certificate of Secondary Education (C.S.E.). It is less academic in approach than the G.C.E. and is being awarded by a number of approved regional examining bodies which have serving teachers from the schools as members. There is a wide variety of subjects and the examination is intended for pupils ranging from those of just below average ability to those reaching the Ordinary level of the G.C.E.

Many educational bodies have already announced that they will accept a Grade I pass of the C.S.E. in lieu of a G.C.E. pass at "O" level in the corresponding subject; and no doubt others will follow.

(e) School-Leaving Examinations in Scotland

Scotland does not use the G.C.E. examinations but has its own Scottish Certificate of Education (S.C.E.), the single examining body being the Scottish Certificate of Education Examinations Board. The examination is held at two levels, Ordinary ("O" level) and Higher ("H" level). The "O" level is normally taken at the age of 16 and the "H" level one year later. The "H" level is thus generally regarded as being of lower standard than the G.C.E. "A" level, which usually requires two years' study above "O" level. Entry qualifications to a Scottish university normally include a minimum of three subjects at "H" level, and the degree course commonly lasts four years.

(f) School-leaving Examinations in Northen Ireland

Northen Ireland follows the practice of England and Wales in using the G.C.E. as the main school-leaving external examination, but also has the Northern Ireland Senior Certificate, which is awarded on specified groups of passes at "O" level in the Northen Ireland G.C.E. examination. There are two examinations below G.C.E. "O" level, leading to the awards of Junior Certificate and Junior Technical Certificate.

6. Technical Colleges

(a) Types of Technical College Course (General)

Technical college courses are predominantly vocational and range from preliminary courses to work at university graduate and post-graduate level. They may be full-time, sandwich, block-release, part-time day or evening-only.

A full-time course is one in which the student attends the college full-time throughout the academic year. The commonest type of sandwich course is one in which the student spends roughly half each year full-time in industry and the other half in full-time attendance at the college. In a block-release course, the student is released by his employer for a number of blocks of full-time study, at the college, each of several weeks and usually totalling from 8 to 18 weeks a year. In a part-time day course, the student is released by his employer for at least one day a week to attend a college course; he may need to supplement this by attending an evening a week in his own time. In an evening-only course, the student attends the college up to three evenings a week in his own private time. An apprentice student is normally given full pay by his employer during attendance on block-release and part-time day courses; in sandwich courses he may be given full pay by the employer or qualify for an award by the local education authority for the periods of college attendance.

Engineering apprentices are almost invariably released by their employers for daytime attendance at college courses and, provided they have made satisfactory progress in studies, rarely have to attend evening-only courses. Some employers are also willing to give selected adult employees the advantage of day-release.

There has been a considerable growth in sandwich and block-release courses for students from industry in recent years, particularly in engineering, for these offer the opportunity of a broader and fuller course than a part-time day one and thus produce a better-qualified apprentice.

There is a notable peculiarity about sandwich courses. Many of the students are "works-based", i.e., they are released for the periods of college attendance from the works (factory, or firm) where they are employed. But students who are not in employment may also attend the course and are then "college-based", in which case the college accepts responsibility for obtaining them suitable practical training during the industrial periods of the course. This facility is often of great value to students from the Commonwealth and overseas who do not want permanent employment in the United Kingdom.

(b) Types of Technical College and their Work

There are over 500 technical colleges in England and Wales, organised on four broad levels of local colleges, area colleges, regional colleges and colleges of advanced technology. Virtually, all of them are co-educational.

The local colleges, of which there are some 300, provide courses mainly of non-advanced level, many of which are integral parts of apprenticeship schemes. They usually offer courses in many fields of study to suit local needs, including craft and technician courses with the latter often only at lower stage, but students who achieve the necessary qualifications for entry to a more advanced course can proceed to an area or other college for it. Some courses, e.g., in secretarial work and domestic subjects, are attended mainly by girls and women. Local colleges usually have some full-time courses, particularly for young students prior to their entering industry or commerce and, although the bulk of the work may be in part-time day courses, block-release and sandwich courses are not uncommon. The colleges usually have evening-only courses but any in engineering are mainly for adult students who do not have day-release.

The 160 area colleges are generally located in larger towns or cities and able to draw from a considerable population. They may offer many of the courses offered in a local college but in addition they provide a range of advanced courses of two to four years for students of 18 upwards, usually including higher technician courses in various fields and in some cases courses of university level, to meet the needs of students and industry in the area. They almost invariably have sandwich courses and often also block-release ones.

The 25 regional colleges (listed in Appendix 2) are concerned mainly with advanced work, including courses of university level, and particularly with full-time and sandwich courses, which often include some for higher technicians. They serve the needs of a geographical region and normally have a comprehensive range of departments, fostering a cultural background for the broader education of their students.

The 10 colleges of advanced technology (listed in Appendix 3) concentrate almost entirely on advanced work over a wide field, including engineering courses of university level, and do not necessarily draw their students from a particular geographical region. They are developing considerable post-graduate work, including research. They are now in process of receiving university status.

Almost all colleges, except the few specialising in one field such as colleges of commerce, offer a range of engineering courses. In local colleges, these may be limited to mechanical and electrical engineering, but area and regional colleges offer courses in other branches, e.g., in electronic, civil, production, marine, mining, chemical, aeronautical and control engineering, according to the demand and support given. In addition to formal qualification courses of two or more years' duration, they offer many types of short course on special aspects and topics of engineering, sometimes at very advanced levels.

The title given to a college is decided by the local authority and is not necessarily an accurate guide to its fields of work. The title "College of Further Education" is very common for local and some area colleges; "Technical College" is common for area colleges but some of the larger ones are called "Colleges of Technology", a title also used by some regional colleges.

Technical colleges, their courses and examinations are dealt with more fully in later chapters.

(c) Technical Colleges in Scotland

In Scotland, there are six technical colleges designated as Central Institutions which are concerned mainly with advanced work, including courses of university level, and particularly with full-time and sandwich courses. Only four of them are concerned with engineering courses at high level.

There are a further nine colleges which provide courses up to advanced level and are regarded as regional colleges in that they serve a region but which are possibly more comparable in size with larger area colleges in England and Wales. The 18 other lower-level colleges might be compared with local colleges in England and Wales.

(d) Technical Colleges in Northern Ireland

In Northern Ireland there are 31 technical colleges. Of the four which can be regarded as regional colleges, one is for Art, one for Domestic Science and one for Commerce. The fourth is Belfast College of Technology where advanced work of university level in engineering is concentrated. The other 27 colleges correspond largely to local colleges in England and Wales; nine of them provide Ordinary National courses and four provide Higher National courses in Engineering (see Chapter II, D.2.(a)).

7. National Colleges and Specialist Colleges

In a few technologies, the demand for advanced courses is insufficient to justify full-scale provision on a local or regional basis and for six of them National Colleges (listed in Appendix 5) have been founded. Three of these are concerned with engineering, viz., the National College of Agricultural Engineering, the National College for Heating, Ventilating and Fan Engineering, and the National Foundry College. In addition, there is the College of Aeronautics, a post-graduate institution which was originally concerned with advanced courses related to aeronautics but has now extended these to cover many fields of engineering, metallurgy and management studies outside the aircraft industry.

Amongst the specialist institutions are the Royal College of Art and some 200 art colleges and agricultural colleges and institutes.

8. Technical Education and Training in the Armed Forces

The three departments of the Ministry of Defence, the Royal Navy, the Army and the Royal Air Force, each have a number of training establishments where technical education and training are provided, particularly for mechanical, electrical, electronic and aeronautical technicians and craftsmen. Many of the students take the same external examinations as their counterparts in civil life in addition to those concerned with their specialised courses on service equipment. Ex-service technicians constitute an important element in the civilian labour force.

9. Government Departments and Nationalised Industries

Special training establishments are provided for technicians employed in certain Government Departments and nationalised industries, but these are mostly concerned with vocational education applied to specific equipment and techniques rather than with general technical education.

10. Colleges within Industry

A few engineering firms have set up educational establishments associated with their own works which provide courses for technicians and craftsmen in their employment. In some cases, students nominated by their clients or associated firms may also attend.

11. The Universities

There are 26 universities in England and Wales. The two oldest, Oxford and Cambridge, each have about 9,000 students. The University of London is a federation of colleges and schools containing 23,000 students. The older universities in the provinces are Durham, Manchester, Birmingham, Liverpool, Leeds, Sheffield and Bristol. The younger ones are Reading, Nottingham, Southampton, Hull, Exeter, Leicester, Keele and Newcastle-upon-Tyne. Finally, there are seven new universities approved since 1958, viz., Sussex, East Anglia, York, Kent, Essex, Warwick and Lancaster. The University of Wales is a federation of colleges in different cities and towns of Wales, with a total of 8,000 students.

The universities are centres both of teaching and research, and the first degree course normally lasts three years. In 1963 there were 98,500 students of whom over 18,500 were engaged on post-graduate work. Over 11,000 were engaged in research, many aiming at a Ph.D. degree.

As mentioned previously, the 10 colleges of advanced technology, also, are now being given the status of universities.

In Scotland, there are now six universities, viz., two in Edinburgh, two in Glasgow and one each in Aberdeen and St-Andrews.

Northern Ireland has one university, at Belfast.

Chapter II

TECHNICAL COLLEGE COURSES AND EXAMINATIONS IN ENGINEERING

"An engineering technician or technician is one who can apply in a responsible manner proven techniques which are commonly understood by those who are expert in a branch of engineering, or those techniques specially prescribed by professional engineers.

Under general professional engineering direction, or following established engineering techniques, he is capable of carrying out duties which may be found among the list of examples set out below.

In carrying out many of these duties, competent supervision of the work of skilled craftsmen will be necessary. The techniques employed demand acquired experience and knowledge of a particular branch of engineering, combined with the ability to work out the details of a task in the light of well-established practice.

An engineering technician requires an education and training sufficient to enable him to understand the reasons for and the purposes of the operations for which he is responsible.

The following duties are typical of those carried out by engineering technicians:

Working on design and development of engineering plant and structures; erecting and commissioning of engineering equipment and structures; engineering drawing; estimating, inspecting and testing engineering constructions and equipment; use of surveying instruments; operating, maintaining and repairing engineering machinery, plant and engineering services and locating defects therein; activities connected with research and development, testing of materials and components and sales engineering, servicing equipment and advising consumers".

This definition is that adopted by the Conference of Engineering Societies of Western Europe and the United States of America (EUSEC).

A. THE VARIETY OF TECHNICAL COLLEGE COURSES

1. An outstanding feature of a large technical college is the diversity and flexibility of the courses it provides, in types, stages or levels, and in subjects.

The types of course, full-time, sandwich, block-release, part-time day and evening-only, have been outlined in Chapter I, D.6 (a).

Courses are offered at two or more stages or levels. Most have an Ordinary or Part I stage of two or three years' duration, followed by a Higher or Part II stage of similar duration. In many subjects, a post-Higher or Part III stage is provided, usually of shorter duration. Examinations are held, and certificates or diplomas awarded, at each stage. Entry to a higher stage is usually conditional on prior success in a lower stage or possession of an accepted equivalent qualification through other studies, e.g., possession of G.C.E. "A" passes in certain subjects might permit direct entry to a higher stage technical course.

A local college may provide Part I and II stages in a craft course but only Part I in a technician course, successful students proceeding to an area college for a Part III craft course or Parts II and III of a technician course. An area college might leave all or most Part I courses to local colleges and itself concentrate on higher-level work. A regional college would deal only with Higher and post-Higher work.

2. The subjects of study vary with the college and the needs of the area it serves. Most smaller colleges offer courses at appropriate stages in Mechanical and Production Engineering, Electrical Engineering, Building, Science, Business Studies and Women's (Domestic) Subjects. In densely populated areas with several colleges within easy travelling distance from each other, subjects may to some extent be shared, e.g., one college might specialise in Mechanical and Production Engineering and the next in Electrical Engineering, while only certain colleges might offer Building courses. Occasionally, a college specialises largely in only one field to suit a strong concentration of a particular industry in the locality, e.g., in Mining or in Boot and Shoe Manufacture.

A large area college would usually offer, within its various departments, courses in most of the following:

- Mechanical and Production Engineering
- Electrical and Electronic Engineering
- Building and Civil Engineering
- Physics, Chemistry, and Sciences such as Biology and Zoology
- Business Studies and Management Studies
- Mathematics (also serving other departments)
- Women's Subjects
- General Studies (non-vocational and serving all departments).

For a particular or regional demand, subjects such as Marine Engineering, Mining, Textiles, Catering, Photography or Printing would be provided.

Some courses may cross several departments, e.g., for a particular G.C.A. "A" course, Departments of Mathematics, Science and Electrical Engineering could be involved or, for a Diploma course in Engineering, Departments of Mechanical and Electrical Engineering will co-operate.

Enrolments in the various courses vary considerably but a typical area college roll might be:

Full-time and sandwich students	1200
Block-release and part-time day students	3500
Evening-only students	2500
Total	7200

B. THE ORGANISATION OF A TECHNICAL COLLEGE

Although the over-riding financial and policy control of a college is vested in the local education authority, all colleges have a Governing Body, made up from representatives of the authority, local industrialists and other persons of standing who are experienced in technical education and the fields of activity of the college. The Governing Body has considerable powers, including the preparation of annual estimates of capital and other expenditure and the appointment of teaching and other staff, though in a large college the junior staff might be appointed by the Principal and a small committee. Most colleges also have Advisory Committees for main departments, with strong industrial representation, whose Chairmen are usually members of the Governing Body.

In a large college, the principal will usually have a Vice-Principal to share the work of organisation and administration, and to act as his Deputy. Each department has its own Head and the teachers range from Principal Lecturer, through Senior Lecturer and Lecturer to Assistant Lecturer. The non-academic staff include laboratory and workshop technicians, maintenance and other craftsmen, senior and junior clerical staff, catering staff, cleaners etc.

Each Departments has its own laboratories, workshops and specialist rooms but general-purpose rooms such as drawing offices and classrooms are often common.

C. TOTAL ENROLMENTS IN TECHNICAL COLLEGES: 1964

In 1964, nearly 838,000 students were enrolled for daytime study in maintained and grant-aided technical colleges and similar establishments in England and Wales. Approximate totals were:

Courses		Enrolments
Full-time		160,000
Short full-time (Up to about a month)		7,400
Sandwich		22,200
Block-release		24,500
Part-time day		623,800
	Total	837,900

In addition, there were 778,000 enrolments for evening-only courses of vocational type.

In November, 1964, over 669,700 of these daytime students and 328,500 of the evening-only ones, making a total of over 998,000, were taking courses leading to recognised qualifications and of these

339,000 were taking engineering courses of various kinds. Over 574,000 were released by their employer to attend daytime courses, of whom 275,600 were under 18 years of age and 93,000 were 21 years and over.

As stated previously, the numbers of sandwich and block-release students are increasing rapidly and a considerable extension of part-time day release is envisaged following the Government Report on Day Release (1964). Many firms are already releasing young workers other than apprentices and trainees for part-time day courses of non-vocational type. Evening-only courses are becoming used more for older students who do not gain day release, though many firms and nationalised industries offer it to adult employees for technical studies.

D. COURSES FOR ENGINEERING CRAFTSMEN, TECHNICIANS AND TECHNOLOGISTS

1. In engineering, the variety of technician occupations is great and the different occupations are not defined by precise standards. The term "technician" is itself rarely used as a designation and is, in fact, hardly recognised by many firms. It is still more a generic term for a broad band of occupations between those of the skilled craftsman and those of the technologist than a title. The border line between the highly skilled and experienced craftsman and the "Junior" technician is often indefinite, while many higher technicians virtually are and sometimes become technologists.

Where, as in the United Kingdom, the title of "engineer" (professional) is not regulated by law or agreement, it is often part of the title of a man who has a post of responsibility yet is in fact not a professional engineer but a technician. Men in comparable posts have different titles in different firms, and men with very different responsibilities may have similar titles, e.g., a development engineer might well be a professional engineer in one firm but a higher technician in another. Even in the respective Services (Navy, Army and Air Force), titles are sometimes not consistent for similar technician grades, service and civilian.

Precise definition of the three groups has long defied solution in engineering and the distinctions cannot be rigid, although they correspond broadly to an ascending order of ability and knowledge. The technologist can, however, be defined as a professional engineer or applied scientist who has qualifications and experience adequate for membership of a professional institution (see E below), can initiate developments and accept a high degree of responsibility.

2. The associations between the craftsman, the technician and the technologist are reflected in engineering courses in technical colleges, in which it is possible for a student showing the necessary ability to transfer or progress from a craft to a technician course or from a technician to a technologist course. The only limiting educational factor in progress from the lower level to the higher is that of ability, and students can move across to another course in a higher series at appropriate points.

For engineering technicians as such, there are two main types of course:

(a) The Ordinary National Certificate and Diploma (O.N.C. and O.N.D. courses, which may be regarded as of technician level, and the Higher National Certificate and Diploma (H.N.C. and H.N.D.) courses, of higher technician level. With supplementary further studies, the H.N.C. and H.N.D. courses can lead to professional engineering qualification and the H.N.D., with its broader content, is commonly so used. All the National Certificate and Diploma courses are associated with the professional engineering institutions (see E, 9 below).

(b) Specific technician courses usually planned for particular groups of technicians, such as those leading to the examinations for Mechanical Engineering Technicians, Electrical Technicians and Telecommunication Technicians held by the City and Guilds of London Institute and the Regional Examining Unions (see F, 2 below).

Though aimed at the needs of the technician and higher technician, the Ordinary and Higher National Certificate and Diploma courses have a greater scientific and mathematical content than the City and Guilds ones and are usually taken by the student with a better educational background. The City and Guilds courses, though not lacking in fundamental studies, are usually planned throughout to give a greater applied emphasis to the various subjects.

Successful students who achieve a pass level of over 60 per cent in specified subjects in ONC or OND courses may be accepted for entry to full time and sandwich degree courses. These may be taken at Colleges of Advanced Technology - which will award their own degrees - or at certain Colleges of Technology recognised for the award of degrees conferred by the Council of National Academic Awards (CNAA). The body has replaced the National Council for Technological Awards, which awarded the Diploma in Technology (Dip. Tech.). This Diploma has been replaced by the CNAA degree. Thus the ONC and OND have a dual function in that they may provide for entry to courses leading to technologist qualifications on the one hand (CNAA degree) or to higher technician (NNC) on the other. The CGLI courses are designed specifically for technicians.

A general survey of the two types of course is given in paras. G and H below, and more detailed information of particular courses is given in succeeding chapters.

3. The diagram on page ... , "Technical College Courses in Engineering", is given for general reference on the relationships of the various engineering courses.

E. THE PROFESSIONAL ENGINEERING INSTITUTIONS

1. The professional institutions in the United Kingdom, including the professional engineering institutions, are independent and autonomous bodies founded by professional men. Many were founded in the nineteenth century and some even earlier (The Royal Society was founded in 1660) and many are incorporated by Royal Charter. They have distinguished and influential memberships of professionally qualified men and women, and include among their objectives the advancement and dissemination of knowledge and the setting up of standards of education, training and degree of responsibility required for their various grades of membership. The Council of each institution, usually on the advice of its appropriately constituted Education and Membership Committees, decides the standards of knowledge and experience to be applied for each grade.

Corporate members have full voting rights and responsibilities, and are regarded as qualified professional men or women. Most of these are classed as Associate Members, e.g., Associate Member of the Institution of Mechanical Engineers (A.M.I.Mech.E.) or Electrical Engineers (A.M.I.E.E.), and there is usually a senior grade such as Membership (M.I.Mech.E., M.I.E.E.) attainable by men distinghished in the profession.

Non-corporate members have no voting rights and are usually men not yet regarded as fully qualified, the chief groups being Students and Graduates. The Student is normally the young engineer-in-training whose educational qualifications and course of training are such that he is likely to become, in time, worthy of professional recognition. The Graduate has usually satisfied the educational requirement for Associate Membership but has not yet satisfied the Council's requirements of responsible practical, industrial or other appropriate professional training and experience.

Corporate members are entitled to show their grade of membership publicly by the appropriate abbreviation after their name, e.g., M.I. Mech.E., A.M.I.E.E.

2. Some of the institutions have very large memberships and their members are to be found all over the world. The institutions publish a regular Journal and other papers, hold conferences, symposia and lecture meetings, and often have local branches in the provinces and overseas. They are not concerned with appointments, salaries or negotiations with employers but purely with the maintenance and development of professional standards. They have naturally exerted a far-reaching influence on education and training for industry and commerce, in which a large proportion of their members are engaged, enabling them to act as a channel for ideas and information on educational, scientific, industrial and commercial principles and practices. This influence has had considerable effect on technical college courses for many years and a great many engineers have satisfied the educational requirements for membership through such courses.

3. The institutions have their own examinations, usually at three stages and often called Parts I, II and III, but these should not be confused with stages of a technical college course which happen to be given a similar designation, for the two may not be comparable. The institutions have always been prepared to consider a technical college course of suitable content and standard for exemption purposes from their own examinations, and for many years have accepted successful completion

of Ordinary and Higher National Certificate and Diploma courses as exempting candidates from certain parts of their own examinations.

4. Thirteen of the leading professional engineering institutions (listed in Appendix 5) have now formed the Council of Engineering Institutions (C.E.I.), which has been granted a Royal Charter, to promote and co-ordinate in the public interest the development of the science, art and practice of engineering. It is the object of the Council to establish, uphold and advance the standards of qualification, competence and conduct of professional engineers; to foster relations with Government, with national and international bodies and with the public; to co-operate with other bodies at all levels of technical and professional competence; to foster co-operation with universities and other educational institutions, and between its members on matters pertaining to the science, art or practice of engineering. Each of the member institutions, however, retains its individual identity and character.

The C.E.I. will admit suitable qualified corporate members of its 13 constituent institutions to the title of "Chartered Engineer" (C.Eng.). The minimum standard of academic attainment which the C.E.I. will exact will be that of a University degree. Holders of suitable degree or degree equivalent certificates will be accepted at the discretion of the C.E.I. Those who have not will be required to pass the two parts of the C.E.I. examination, or the second part if they have acceptable exempting qualifications from the first. It is likely that the present educational standards of most of the 13 institutions will fail to meet the C.E.I.'s requirements for C.Eng. Thus there is likely to be a general raising of the educational standards of the engineering institutions, accompanied by a diminution in the extent to which H.N.C. and H.N.D. will qualify for exemption. Indeed, it seems likely that the H.N.C. will, within a few years, cease to lead to professional qualification and will exist solely as a higher technician certificate. The O.N.C. will continue, as now, in the dual role of a bridge to full-time professional courses for very able students and as a preparation for H.N.C. for those who will become technicians.

F. THE CITY AND GUILDS OF LONDON INSTITUTE AND THE REGIONAL EXAMINING UNIONS

1. The City and Guilds of London Institute (often called simply the City and Guilds or abbreviated to C.G.L.I.) was founded in 1878 and derives its present authority from a Royal Charter granted in 1900. Its aim is to provide technical and scientific education for the individual, to industry, to the nation, and to the Commonwealth and other countries. Its purpose in offering examinations is to promote the establishment of courses of study, to set up nationally recognised standards of attainment and to provide machinery whereby industries can develop schemes of further education which are integral components of apprenticeship and other training schemes. Its schemes for courses and examinations show a very considerable degree of diversity, catering for operatives, craftsmen, technicians and technologists in a wide range of industries and fields. In 1963-64, the total number of candidates was over 225,000, of whom some 27,000 were overseas. Examinations were held in over 220 subjects and at over 1,300 local centres.

The Institute is independent and autonomous, working through its Examinations Board and Advisory Committees, of which there are over 150, each responsible for a particular group of courses or single course. On each Advisory Committee are representatives from industry, the professional institutions, the Teachers' Associations, local education authorities, research institutions, interested Government departments, the appropriate City of London Guild or Livery Company, the Department of Education and Science, the Departments of Education for Scotland and Northern Ireland, and other interested bodies.

The Institute constantly receives requests from industry for new courses and examinations for particular categories of personnel. If a request seems appropriate it is first considered by the Examinations Board and the Educational Policy Committee. On their approval, an Exploratory Committee is set up, with a constitution similar to that of an Advisory Committee, and has the responsibility for considering the feasibility of the proposal and for drafting the complete scheme of curricula, syllabuses etc. The Exploratory Committee considers matters such as the precise identification of the type of student to be catered for, the numbers of potential students, their general educational standard and probable future employment and promotion, any relevant industrial training schemes, an appropriate curriculum and syllabuses, and the most suitable method of examination.

The report of the Exploratory Committee is considered by the Examinations Board and the Educational Policy Committee and if they are satisfied that the proposed scheme is educationally and industrially sound, it is formally adopted and published widely.

The Exploratory Committee is then reconstituted as a standing Advisory Committee for the scheme, which it continues to control within the general framework of the Institute's objectives and the context of the educational system. The Advisory Committee has to keep the structure of the scheme and syllabuses under constant review, so that the examinations remain relevant to current industrial and educational practice, to maintain contact with the colleges, recommend examiners, moderate through a confidential sub-committee all examination papers, and generally advise the Institute on all matters relating to the scheme.

With this system, the Institute is no remote authoritarian body but one through which those intimately connected with industry and education come together to identify educational and training requirements and to decide how best they may be met.

2. The Regional Examining Unions (listed with the City and Guilds in Appendix 6) are corresponding independent examining bodies, of associations of local education authorities in geographical areas of England and Wales. Their purpose is to establish schemes of curricula and syllabuses in various subjects and to hold examinations at the end of each year of courses in the technical colleges of the area. They similarly have their Examinations Board and Advisory Committees for each group of subjects or single subject. Where they hold examinations in the same field as the Institute, syllabuse are co-ordinated to lead up to the Part II or other final examination of the Institute.

3. There are two points of difference between the City and Guilds and the Regional Examining Unions. The Institute does not administer National Certificate or Diploma schemes or examinations whereas the Unions offer approved syllabuses and examinations for these for colleges which wish to use them. The C.G.L.I., however, offers a much larger range of craft and technician courses than do the Regional Examining Unions, for these include the advanced and highly specialised courses for which there is insufficient demand to warrant more than one examining body. Thus for this range of courses the C.G.L.I. is a national examining body.

G. ORDINARY AND HIGHER NATIONAL CERTIFICATE AND DIPLOMA COURSES IN ENGINEERING

1. The term "National" in the title of these courses means that the courses are approved under a national scheme and under national, not local, standards. It does not mean that there is only one national set of syllabuses or only one national set of examinations. Subject to certain provisos, any college may have its own approved schemes of curricula and syllabuses, and set its own internal examinations. Alternatively, colleges in an area may run common schemes and the Regional Examining Unions offer approved schemes which colleges may use; the syllabuses and examinations then become external. The majority of colleges have their own schemes and internal examinations for O.N.C.

Their is a growing body of opinion that it would be advantageous to adopt common national syllabuses and external examinations for O.N.C. and O.N.D. courses, as in Scotland (see paras. G.9 (b) and Chapter IV, C.1), since the syllabuses of individual colleges at this level are much the same. It is not suggested that this should apply to H.N.C. and H.N.D. courses, where there may be appreciable differences between colleges to meet local requirements.

2. College schemes for O.N.C., O.N.D., H.N.C. and H.N.D. courses, though individual, must conform to general regulations called Rules and must be submitted for prior approval to Joint Committees. These are autonomous bodies and consist of members nominated by the professional institutions concerned, the Department of Education and Science (whose nominees are H.M. Inspectors) and the Teachers' Associations. The Joint Committee must be satisfied on the content and arrangement of the scheme, the entry conditions, the time to be devoted to each subject, the proportion of time for laboratory work, the content and standard of the syllabuses, the qualifications of the teachers nominated, and the accommodation and equipment of the college, as reported by H.M. Inspectors.

While maintaining standards, this system allows colleges a considerable degree of freedom in arranging courses to suit local needs, particularly in the higher-level courses.

The final examination papers are set by the college teachers or the Regional Examining Union and must be approved on behalf of the Joint Committee by experienced assessors appointed by the professional institution, before the examinations are held. The scripts are marked by the college teachers and then moderated by the assessor, whose decision on marking is final. The issue of pass lists and the award of Certificates and Diplomas are made by the Joint Committee, the awards being dependent on satisfactory attendance and work during the course as well as performance in the examination. Certificates are awarded for part-time day or evening courses and for block-release courses, which are regarded as extended part-time day ones. Diplomas are awarded for full-time and sandwich courses. The latter, with their allied industrial experience, are considered particularly valuable in the engineering field.

3. The National Certificate and Diploma schemes, in Mechanical Engineering, began in 1921, and were followed by schemes in Electrical Engineering in 1923, by Production Engineering in 1941, by Civil Engineering in 1943, by Chemical Engineering in 1951 and by Aeronautical Engineering in 1958. Ordinary Certificates and Diplomas were available only in Mechanical Engineering and Electrical Engineering, these courses being used as a basis for the Higher ones in the other branches of Engineering.

4. Following the Government White Paper of 1961 on "Better Opportunities in Technical Education", the pattern of engineering courses for craftsmen, technicians and technologists was reformed, in both National Certificate and Diploma courses and those of City and Guilds type. Separate O.N.C.s. and O.N.D.s. in Mechanical and Electrical Engineering were ended and are now replaced by the O.N.C. and O.N.D. in Engineering, which include compulsory elements of both mechanical and electrical engineering. The separate H.N.C. and H.N.D. schemes in Mechanical engineering, Electrical and Electronic Engineering, Production Engineering etc. continue, however, and to provide the necessary preliminary specialist studies for each of these, a considerable variation is allowed in the selection of subjects in the final year of the O.N.C. course in Engineering. There is less need for such variation in O.N.D. courses, since their longer time permits a course fuller in content and broader in treatment than the O.N.C., meeting the entry requirements for most H.N.C. courses.

5. Not all students proceed to the Higher courses, for the O.N.C. and O.N.D. are complete courses in themselves and represent a reasonable ceiling for some grades of technician.

6. Entry to the former three-year O.N.C. and O.N.D. courses in Mechanical or Electrical Engineering was not dependent on prior success in an external examination and the broad entry conditions had often proved inadequate as a reliable indication of a student's suitability for a course of the academic standard of the O.N.C., resulting in wasted effort, frustration and too high a failure rate. With the advent of the new two-year O.N.C. and O.N.D. in Engineering, entry conditions were altered to require prior qualification through an approved external examination, normally either the G.C.E. at "O" level or that of a new two-year course, the General Course in Engineering (see Chapter III), instituted at the same time by the City and Guilds and the Regional Examining Unions.

Further details of typical O.N.C. and O.N.D. courses are given in Chapter IV.

7. There have also been recent developments relating to H.N.C. and H.N.D. schemes. A single Joint Committee has been formed for them in Mechanical, Production and Aeronautical Engineering, while those for Electrical Engineering have been extended to cover electronic engineering and are now the H.N.C. and H.N.D. in Electrical and Electronic Engineering. Further developments may arise, particularly as a result of the recent formation of the Council of Engineering Institutions.

8. As stated previously, the professional institutions have for many years given exemptions from some of their own examinations, on a subject-for-subject basis, to students gaining National Certificate and Diploma awards, though additional studies have invariably been required for full exemption, and the courses have been used by a great many students as a route to professional membership. The higher educational standards now required for corporate membership of the engineering institutions make part-time studies less and less satisfactory as a preparation for a professional career and make it increasingly difficult for students to qualify through H.N.C. and post-H.N.C. studies. Students aiming at membership through technical college courses are therefore now being strongly recommended by the institutions to take a sandwich or full-time H.N.D. course, or a degree course for a Diploma in Technology or a degree.

Entry to H.N.C. and H.N.D. courses has always been based on prior success in an assessed examination, e.g., for the O.N.C. or O.N.D., or in a recognised external examination such as the G.C.E. at "A" level.

Further details of typical H.N.C. and H.N.D. courses are given in Chapter V.

9. National Certificate and Diploma Schemes in Scotland and Northern Ireland

(a) The Joint Committees for National Certificate and Diploma schemes in Engineering in Scotland and Northern Ireland are mostly separate from those of England and Wales, and the Scottish and Northern Ireland Departments of Education administer their own schemes.

(b) Scotland has not adopted the new O.N.C. and O.N.D. schemes in Engineering but continues to use separate O.N.C.s. in Mechanical Engineering and Electrical Engineering. The O.N.D. is offered only in Mechanical Engineering but the curriculum includes electrical subjects so that a successful student can proceed to a H.N.C. or H.N.D. course in Electrical and Electronic Engineering.

Since Scotland does not use the G.C.E. but the S.C.E. (Scottish Certificate of Education) for its school-leaving examination, nor the General Course in Engineering, the normal entry qualification to O.N.C. and O.N.D. courses is a minimum number of passes in prescribed subjects of the S.C.E. at "O"llevel.

Additionally, Scotland has adopted a national system of syllabuses and examinations for National Certificates and Diplomas which all colleges use (see Chapter IV, § C.1), though there are permissible variations in non-compulsory subjects in individual college schemes.

(c) Northern Ireland has followed England and Wales in adopting the new O.N.C. and O.N.D. schemes in Engineering, and for entry qualifications uses both the G.C.E. at "O" level and the General Course in Engineering. It has its own H.N.C. and H.N.D. schemes in the separate branches of Engineering.

10. Appendix 7 gives a list of Joint Committees for National Certificates and Diplomas in various branches of Engineering in the United Kingdom, together with the official numbers of the Rules governing them and details of the Secretariats for the Joint Committees.

Appendix 8 gives the numbers of candidate entries to National Certificate and Diploma examinations in the various branches of Engineering for the years 1963 and 1964. These do not include any figures for the new O.N.C. in Engineering, the first examinations for which are being held in 1965.

H. SPECIFIC TECHNICIAN COURSES IN ENGINEERING

1. As mentioned previously, examinations for specific technician courses in Engineering are held by the City and Guilds and the Regional Examining Unions. Although these bodies are, strictly speaking, examining bodies only, their syllabuses and examinations cover complete courses of the relevant required subjects. For example, a complete course might require the subjects of Mathematics, Engineering Science, Engineering Drawing, Workshop Technology and General Studies. Their Regulations therefore make general recommendations for the necessary courses of study, which are thus commonly called City and Guilds or Regional Examining Union Courses, though colleges are free to make their own arrangements in the conduct of the studies.

2. The City and Guilds Institute has a considerable number of courses of technicians, many of which are also offered by the Regional Examining Unions. Some are referred to as "ab initio" technician courses since they are planned for technicians from the beginning, while others are referred to as "end-on" technician courses because they are planned to follow successful completion of a preparatory or perhaps a craft course. Regulations and syllabuses are reviewed at intervals and where the course has several stages the tendency is now to call these Part I, Part II etc., but terms such as Intermediate, Final and Endorsement Subjects are still used. Endorsement Subjects are additional, corresponding to a Part III stage, and are so-called because success in them was at one time recorded by an endorsement on the Final Certificate, though separate Endorsement Subjects Certificates or Supplementary Certificates are now issued.

3. In certain courses which reach an advanced level and contain sufficient breadth of studies, the Institute offers additionally the award of Full Technological Certificate (F.T.C.) at the final stage, but before the award is made the candidate must have reached the age of 21 years and had appropriate industrial experience. He may also have to satisfy conditions of success in earlier or related courses. The Institute is reviewing the system of F.T.C. awards and the fact that a particular course does not at present offer the F.T.C. is no reflection on its standard or breadth of study.

4. The more important engineering technician courses of the Institute are listed below, with their official course numbers. The addition of "(F.T.C.)" denotes that the final stage can also carry the award of a Full Technological Certificate.

Course No.	Course
287	General Course in Engineering (a preliminary qualifying course)
293	Mechanical Engineering Technicians' Course, Parts I, II and III (F.T.C.)
57	Electrical Technicians' Course, Intermediate, Final and Endorsement subjects (F.T.C.)
49	Telecommunication Technicians' Course, 1st., 2nd., 3rd., and 4th. Years.
300	Supplementary Studies in Telecommunications and Electronics (F.T.C.)
51	Electrical Installation Work, Course "C" (F.T.C.)
181	Heating and Ventilating Engineering Technicians' Course (F.T.C.)
310	Industrial Measurement and Control Technicians' Certificate Course, Parts I, II and III (F.T.C.)
312	Instrument Production Technicians' Certificate Course (F.T.C. under consideration)
170	Motor Vehicle Technicians' Work Course (F.T.C.)
318	Vehicle Body Engineering Technicians' Certificate Course
171	Aeronautical Engineering Practice Course, Parts I, II and III (F.T.C.)

175 Aircraft Electrical Practice Course, Parts I, II and III (F.T.C.)

289 Shipbuilding Technicians' Course, Parts I and II

261 Agricultural Engineering Technicians' Certificate Course (F.T.C.)

154 Metallurgical Technicians' Certificate Course

155 Metallurgical Technicians' Advanced Certificate Course (F.T.C.)

321 Foundry and Pattern Shop Technicians' Certificate Course, Part I

For overseas centres only there are also the following courses:

327 Ordinary Technicians' Diploma in Mechanical and Electrical Engineering

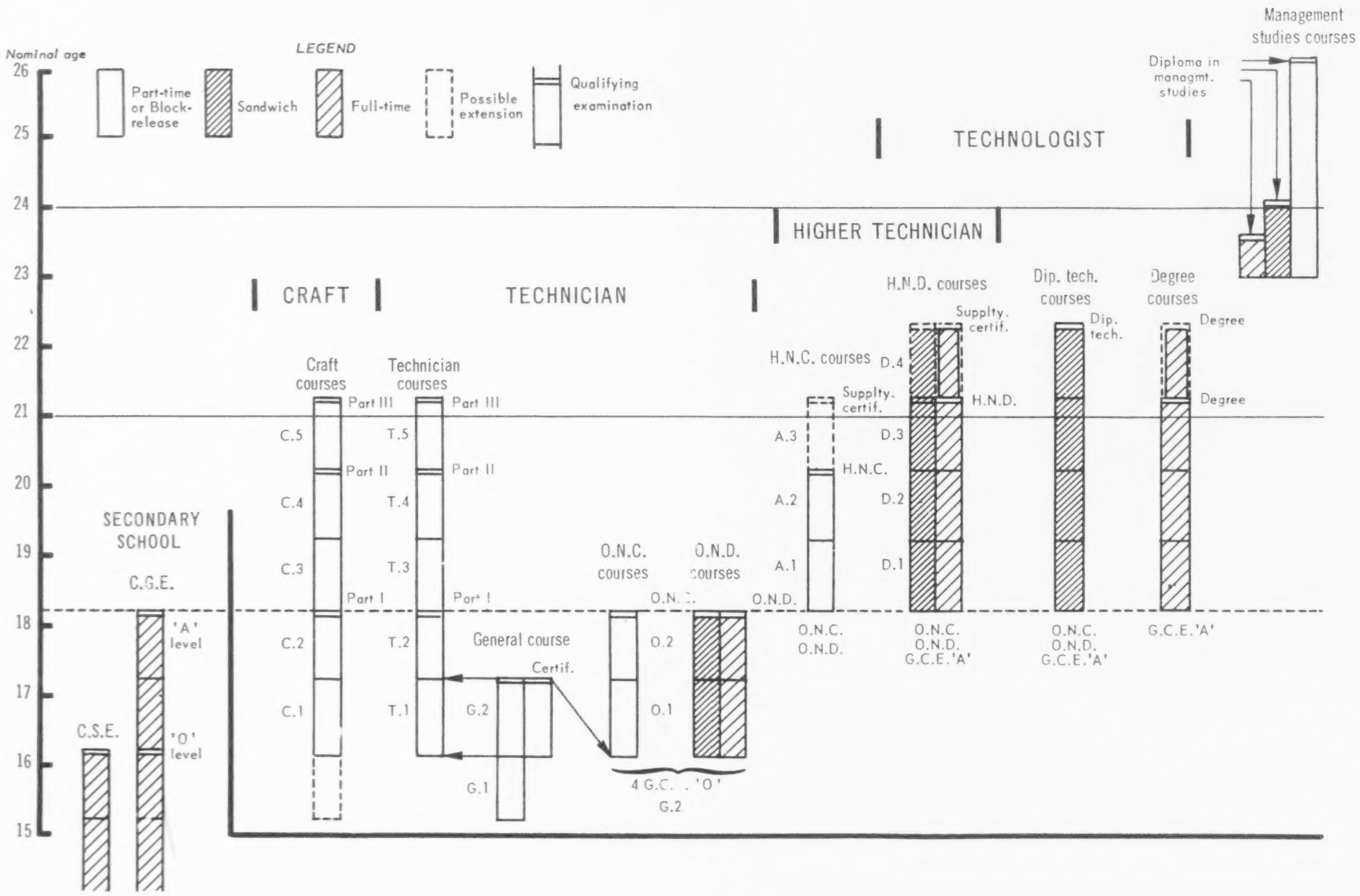
303 Higher Certificate in Mechanical Engineering

305 Higher Certificate in Electrical Engineering

The two latter Higher Certificates are likely to be replaced by Higher Technician Diploma Courses.

5. Details of some of the above courses are given in later chapters. The Institute publishes separate Regulations and Syllabuses for each of its courses.

TECHNICAL COLLEGE COURSES IN ENGINEERING


Nominal age
26
25
24
23
22
21
20
19
18
17
16
15
LEGEND
Part-time or Block-release
Sandwich
Full-time
Possible extension
Qualifying examination
TECHNOLOGIST
HIGHER TECHNICIAN
CRAFT
TECHNICIAN
Management studies courses
Diploma in managmt. studies
SECONDARY SCHOOL
C.G.E.
C.S.E.
'A' level
'O' level
Craft courses
C.1
C.2
C.3
C.4
C.5
Part I
Part II
Part III
Technician courses
T.1
T.2
T.3
T.4
T.5
Part I
Part II
Part III
General course
Certif.
G.1
G.2
O.N.C. courses
O.1
O.2
O.N.C.
O.N.D. courses
4 G.C. . 'O'
G.2
H.N.C. courses
O.N.D.
A.1
A.2
A.3
H.N.C.
Supplty. certif.
O.N.C.
O.N.D.
H.N.D. courses
D.1
D.2
D.3
D.4
H.N.D.
Supplty. certif.
O.N.C.
O.N.D.
G.C.E.'A'
Dip. tech. courses
Dip. tech.
O.N.C.
O.N.D.
G.C.E.'A'
Degree courses
Degree
Degree
G.C.E.'A'

Chapter III

THE GENERAL COURSE IN ENGINEERING

1. The General Course in Engineering is intended for school leavers of 15 or 16 who show promise of being able to qualify as engineering technicians. It is planned as a two-year course of part-time day studies in a technical college and gives a common grounding for students in mechanical, electrical and other branches of engineering. It may also be provided as a block-release or sandwich course and a number of colleges have such courses.

General Courses in Mining, Shipbuilding, Science, Textiles and Construction (building and civil engineering) have also been introduced.

2. Entry and Selection

Pupils leaving school at 15 who appear from their school record and other evidence to be capable of reaching the standard for either a specific technician course in Engineering or the O.N.C. or O.N.D. course in Engineering enter the first year, G.1, of the General Course. At the end of this, they either transfer to the first year, T.1, of the technician course or, if they show sufficient promise for the prescribed O.N.C. and O.N.D. entry, continue with the second year, G.2., of the General Course. Their performance at the end of this determines their selection for the following course. Credits in Mathematics and Engineering Science and a pass in Engineering Drawing or Workshop Processes and Materials admit them to the first year, O.1, of the O.N.C.D. course. Passes in Mathematics and two other technical subjects admit them to the second year, T.2, of a technician course. Otherwise they may have to enter the technician course at first-year, T.1, level.

Pupils leaving school at 16 who have not gained the G.C.E. "O" passes required for direct entry to the O.N.C.D. but have taken suitable lead-in studies may enter the General course at second-year, G.2, stage, and complete the course in one year. Alternatively, if their school record does not justify expectation that they will achieve O.N.C.D. entry, they may proceed straight to the first year, T.1, of the technician course and omit the General course.

The General course thus provides a diagnostic as well as a progressive educational period in which to decide whether the student is better suited for a specific technician course or to an O.N.C.D. course, but does not involve him in any loss of time or progession. It is equally valuable for either type of following course.

3. Curriculum

The subjects for each year of the course are as follows:

Mathematics
Engineering Science
Workshop Processes and Materials
Engineering Drawing
English and General (non-technical) Studies

The syllabus for Engineering Science includes both mechanical and electrical topics and it is recommended that not less than one third of the total time for the subject should be spent on laboratory work. A list of experiments suitable to be carried out by the students is included with the syllabus as a guide to teachers in planning the laboratory schemes and students are expected to record their work in laboratory notebooks.

The subject of Workshop Processes and Materials includes a scheme of practical work for each year, to be regarded as laboratory work in mechanical and electrical workshop processes and materials, not as training in skills or as a collection of set "exercises". Its syllabus includes a list of suitable investigations and tests as a guide to the teacher in planning schemes of practical work, and students are expected to record their investigations.

The subject of English and General Studies is left to the college. Although no syllabus is offered and no external examination is set, the subject is considered a most important part of the course. The technician needs the ability to speak and write good English, as well as a background of broad interests and knowledge. There is scope for much variation and experiment in this field of study and it is agreed that colleges should have freedom to develop it in their own way. The Department of Education and Science Report "General Studies in Technical Education" (1964) is of value to teachers in planning the course of study.

4. Arrangement of the course

The arrangement of the course is left to the college, except that a minimum total of 240 hours in each is expected for the four technical subjects, excluding English and General Studies. In block-release and sandwich courses, more time is expected.

5. Examinations and Award of Certificates

The course is examined at the end of the final year by the City and Guilds and the Regional Examining Unions, whose syllabuses are co-ordinated. Some of the Unions offer an examination at the end of the first year but this is solely for colleges which desire an external assessment of progress at that stage.

The final examination is based on the whole of the syllabus and a paper is set in each technical subject. There are two levels of pass, designated "Pass" and "Credit" in each subject. Certificates are awarded to candidates who take the whole examination and pass in one or more subjects, and indicate the level of pass in each subject since this factor is important in the allocation of students to their next courses as stated above.

Chapter IV

ORDINARY NATIONAL CERTIFICATE AND DIPLOMA COURSES IN ENGINEERING

A. ORDINARY NATIONAL CERTIFICATE SCHEMES IN ENGINEERING IN ENGLAND AND WALES

1. The O.N.C. course is normally a two-year part-time day or block-release course with a minimum total of 240 hours for the technical subjects in each year. It must also include English and General Studies desirably totalling about 90 hours in each year. As a result, although evening-only courses are acceptable they normally have to be extended to three years.

2. The Joint Committee

The Joint Committee for the schemes is constituted from the Institutions of Civil, Mechanical, Electrical, Production and Chemical Engineers, the Royal Aeronautical Society, the Department of Education and Science and representatives from the Teachers' Associations. As outlined previously, before approving a scheme, the Joint Committee has to be satisfied about the accommodation and equipment of the college, the qualifications of the teachers, the standards of admission to the course, the curriculum and syllabuses, the time to be devoted to each subject and to laboratory work, and the examination arrangements.

3. Entry Conditions

For admission to the first year of the course, a student must possess one of the following qualifications:

(a) The G.C.E. at "O" level in four subjects including Mathematics and one of the following: Physics, Physics with Chemistry, Mechanics, Mechanical Science, Engineering Science, Science (Building and Engineering) or other Science subjects specifically approved.

(b) Satisfactory completion of the General Course in Engineering and possession of the Course Certificate with Credit in Mathematics and Engineering Science and a Pass in Engineering Drawing or Workshop Processes and Materials.

(c) Any other qualification approved by the Committee.

The Committee has published a Table of Exemptions, NC/67/63, which indicates approved other qualifications of (c) above and also subject exemptions that may be granted to holders of certain other qualifications, e.g., holders of the G.C.E. "A" in appropriate subjects or of other O.N.C.s., but these affect only a very small proportion of students. Holders of first-class passes in the Part I examinations of certain City and Guilds technician courses may enter under qualification (c) but it is generally considered better for them to complete the technician course to Part II stage and then proceed to a H.N.C. course, omitting the O.N.C.

4. Curriculum

The technical subjects of the course are as follows:

First year (O.1)

(i) Mathematics I

(ii) Mechanical Engineering Science

(iii) Electrical Engineering Science
(iv) Engineering Drawing and/or Physics I or Physical Science

Students without a previous qualification in Engineering Drawing (such as G.C.E. "O" or the General Course in Engineering) are required to take the subject. Those with such a qualification may take Physics I or Physical Science. Additional optional subjects such as Workshop Technology may be taken if extra time is available.

Second Year (O.2)

(i) Mathematics II

and not less than three from the following:

(ii) Applied Mechanics
(iii) Applied Heat
(iv) Workshop Technology or Instrument Technology
(v) Electrical Engineering A
(vi) Electrical Engineering B
(vii) Physics II or Engineering Chemistry
(viii) Mechanics of Fluids or Aerodynamics
(ix) Elementary Surveying
(x) Materials and Structures
(xi) Engineering Drawing and Design
(xii) Additional subjects as approved by the Joint Committee

The O.N.C. is awarded on the successful completion of Mathematics II and any two other main technical subjects (see para. A.5) but a minimum of four subjects must be taken, Mathematics II and any three others. In exceptional circumstances the college Principal may permit a particular student to discontinue one technical subject of the minimum four, other than Mathematics II.

In preparing schemes, colleges need to include O.2 subjects suitable for entry to the H.N.C. courses which their students intend to take subsequently. A student proceeding to a H.N.C. in Mechanical Engineering would need Applied Mechanics and either Applied Heat or Workshop Technology; one preparing for the H.N.C. in Production Engineering would need Applied Mechanics and Workshop Technology; one intending to take the H.N.C. in Electrical and Electronic Engineering would want at least one of the Electrical Engineering subjects and possibly Physics II. Rule 126 governing the schemes have Appendices to give guidance on such requirements.

5. Conditions for the Award of the O.N.C.

(a) A candidate must normally have attended for not less than two thirds of the prescribed time for each subject.

(b) Promotion from the first to the second year is at the discretion of the Principal.

(c) A candidate must qualify in Mathematics and two other main technical subjects. If he takes the minimum four subjects and fails only in Mathematics II he may be referred in that subject for up to one year, his O.N.C. award being deferred until he qualifies in it. This normally means that he is not held back from starting a higher course. If he fails to qualify in three subjects he must repeat the O.2 year.

(d) He must have reached the qualifying marks in the final year for homework, classwork and laboratory work in each main subject, and his award is based on these as well as on his final examination marks.

(e) A Distinction in any subject may be awarded to a successful candidate who gains not less than 85 per cent of the total final marks in that subject.

(f) A student who qualified in approved subjects subsequent to successful completion of the course is awarded Supplementary Certificates for attachment to the O.N.C. These subjects may also carry a distinction.

6. The system of assessment of examination papers, of the marking and moderation of scripts, and the issue of the award have been dealt with in Chapter II § G.2 above.

7. O.N.C. Courses in Engineering in Northern Ireland

The Rules and arrangements for O.N.C. courses in Engineering in Northern Ireland are not significantly different from those in England and Wales. All colleges, however, have common syllabuses and the final examination is an external one arranged by the Ministry of Education for Northern Ireland, acting as an Examining Body.

B. ORDINARY NATIONAL DIPLOMA SCHEMES
IN ENGINEERING IN ENGLAND AND WALES

1. The O.N.D. course is a two-year sandwich or full-time course, preferably a sandwich one. No minimum time content is prescribed but the content is usually not less than 720 hours in each year.

2. The Joint Committee

The Joint Committe is the same as that for the O.N.C. in Engineering.

3. Entry Conditions

Entry conditions are the same as those of the O.N.C. in Engineering.

4. Curriculum

The subjects of English and General Studies must be included in both years of the course. The eight compulsory and examined subjects in the final year should be:

Second Year (O.2)

(i) Mathematics
(ii) Applied Mechanics

(iii) Electrical Engineering I
(iv) Electrical Engineering II
(v) Workshop Technology
(vi) Applied Heat
(vii) Physics
(viii) Engineering Drawing

In special cases, the Joint Committee is prepared to consider alternative proposals involving a similar length of study and reaching a similar standard.

Subjects for the first year are not prescribed but must be appropriately designed to lead into the second year.

5. Conditions for the Award of the O.N.D.

(a) A candidate must normally have attended for not less than 80 per cent of the prescribed time for each subject.

(b) Unless granted exemption by the Joint Committee, he must take all subjects in each year of the course.

(c) Promotion from the first to the second year is at the discretion of the Principal.

(d) A candidate must qualify in the final examinations in Mathématics, Applied Mechanics, Electrical Engineering I, Electrical Engineering II, Engineering Drawing and either Applied Heat or Physics. A pass in Workshop Technology is shown on the Diploma but does not count for the award. A candidate who fails by not more than 10 per cent in only one of the six compulsory examination subjects may be awarded the Diploma provided his total mark for the eight subjects reaches the qualifying total.

Note: This course is being revised and is likely to require in future six technical subjects in the second year of the course, with passes in five as the criterion for success.

The remaining conditions are similar to those of the O.N.C. in Engineering, above, as are the requirements for assessment of papers, the marking and moderation of scripts and the issue of awards.

6. O.N.D. Schemes in Engineering in Northern Ireland

The Rules and arrangements for O.N.D. courses in Engineering in Northern Ireland are not significantly different from those in England and Wales Except that

(a) The curriculum for the second year includes the additional subjects of:

- (ix) Mechanics of Fluids or Aerodynamics
- (x) Elementary Surveying
- (xi) Materials and Structures

(b) Mathematics and any seven of the other ten subjects (see B, 4 above) must be studied.

(c) A candidate must qualify in Mathematics and six of the seven other subjects he has studied.

C. ORDINARY NATIONAL CERTIFICATE AND DIPLOMA COURSES IN MECHANICAL ENGINEERING AND ELECTRICAL ENGINEERING IN SCOTLAND

1. As stated in Chapter II, § G.9 (b) Scotland still retains separate O.N.C. schemes in Mechanical Engineering and Electrical Engineering and offers O.N.D. schemes only in Mechanical Engineering. The common syllabuses and external examinations used by the colleges are controlled by a central co-ordinating body known as the Scottish Association for National Certificates and Diplomas (SANCAD), on which the colleges are represented and which acts somewhat like a Regional Examining Union in England and Wales. All college schemes, Ordinary and Higher, are submitted through SANCAD, and its Secretary or his deputy is normally invited to attend meetings of the Joint Committees as an observer.

2. O.N.C. courses extend over not less than two years with a minimum of three approved subjects in each year. Part-time day or evening-only courses must have a minimum total of 240 hours of study in each year, excluding any non-compulsory subjects. Block-release courses must have a minimum total of 360 hours of study in each year, excluding the additional time given to tutorial classes held at the college between the block-release periods.

O.N.D. courses may be either sandwich or full-time and must extend over two years, with a minimum total of 1,500 hours of study over the two years.

3. The Joint Committees

For Mechanical Engineering schemes, the Joint Committee is constituted from nominees of the Institution of Mechanical Engineers and H.M. Inspectors of the Scottish Education Department, with the Secretary of SANCAD as observer. For Electrical Engineering schemes, the Joint Committee is similar but with nominees of the Institution of Electrical Engineers instead of the Institution of Mechanical Engineers.

4. Entry Conditions

For entry to the first year of either O.N.C. or O.N.D. courses, a student must possess the Scottish Certificate of Education with passes at Ordinary level in Mathematics, Physics or Applied Mechanics, and technical Drawing, or such other entrance qualifications as the Joint Committee may approve.

5. Curricula

The compulsory and any additional subjects of the curricula for O.N.C. and O.N.D. courses are not specified in the Scottish Rules, as they are in those for England and Wales, but in practice the compulsory subjects for the O.N.C. courses are at present as follows.

(a) O.N.C. course in Mechanical Engineering

First Year (O.1)

- (i) Mathematics
- (ii) Mechanical Engineering Science
- (iii) Engineering Drawing

Second Year (O.2)

- (i) Mathematics
- (ii) Applied Mechanics
- (iii) Applied Heat or Workshop Technology

(b) O.N.C. course in Electrical Engineering

First Year (O.1)

- (i) Mathematics
- (ii) Mechanical Engineering Science
- (iii) Electrical Engineering Science

Second Year (O.2)

- (i) Mathematics
- (ii) Electrical Engineering, A.
- (iii) Electrical Engineering, B.

Where time affords, an additional subject or subjects may be added in each O.N.C., which may be the second alternative subject in the Mechanical course, one of the Mechanical subjects in an Electrical course or vice versa, or a subject such as Heat, Light and Sound or Physics.

(c) O.N.D. course in Mechanical Engineering

The O.N.D. course usually includes the compulsory subjects of both the Mechanical and Electrical O.N.C. schemes plus an additional relevant subject or subjects.

6. Conditions for the Award of the O.N.C. and O.N.D.

(a) A candidate must normally have attended for not less than 75 per cent in an O.N.C. course and 80 per cent in an O.N.D. course of the possible total attendance in each subject.

(b) He must have taken the approved course in consecutive years and sit all the appropriate examinations of any one stage in the same year.

(c) Promotion from the first to the second stage is at the discretion of the college Principal.

(d) A candidate must qualify in each of the subjects of the final year which are necessary for the award according to the approved scheme, in two respects, viz:

- (i) In the college evaluation of his performance in classwork, laboratory work where applicable and in periodic class tests;
- (ii) In the final examination.

(e) If he fails to meet the requirement of (d) above in only one of the compulsory subjects of the final stage, at the discretion of the Joint Committee he may be allowed one re-presentation of the subject within two years, for which he must re-attend the appropriate class, undertaking all its work, and re-sit the final examination in the subject. Otherwise, he must repeat the final year.

(f) A pass with Special Mention in any assessed subject shall be awarded to a candidate who gains the award at first presentation and obtains not less than 80 per cent of the possible total marks in that subject.

(g) An O.N.C. or O.N.D. with Distinction shall be awarded to a candidate who gains the award at first presentation and obtains not less than 75 per cent of the possible grand total of marks in the final year.

(h) Supplementary Certificate courses are single-subject courses approved as extensions of the main course but, under certain conditions, they may be taken during attendance on the main course as well as after successful completion of it.

7. The system of assessment of examination papers, of the marking and moderation of scripts and the issue of the awards follows that of England and Wales.

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Chapter V

HIGHER NATIONAL CERTIFICATE AND DIPLOMA COURSES IN ENGINEERING

1. As stated previously, the H.N.C. scheme is separate from that of H.N.D. for the different branches of Engineering such as Civil Engineering, Mechanical Engineering, Electrical engineering and Production Engineering. They do not have any prescribed curricula under the Rules but there is usually a common core of subjects in each, supplemented by one or more subjects to suit the needs of students. For example, H.N.C. schemes in Mechanical Engineering will invariably have a common core of Mathematics, Properties and Strength of Materials, and Theory of Machines, to which will be added one or more subjects such as Thermodynamics, Principles of Engineering Production, Metallurgy and Mechanics of Fluids. Similarly, H.N.C. schemes in Electrical and Electronic Engineering will have a common core of Mathematics and Electrotechnology, with further subjects such as Electrical Machines, Electrical Supply, Electronics, Communications Engineering and Engineering Physics.

H.N.D. courses have a similar common core and additional subjects but they also afford time for a fuller content and broader treatment. They do not normally go to a more advanced level in individual subjects than a H.N.C. course.

2. A H.N.C. course is basically a two-year part-time or block-release course, but many students, particularly those aiming at professional recognition, go on to a third and often a fourth year, for which Supplementary Certificates may be awarded. The course must have a minimum of

three subjects in each of its two years, and in one of minimum time-content, such as an evening-only course, only three subjects can be attempted. In part-time day and evening, and in block-release courses however, four subjects are usual in each year.

3. A H.N.D. course is a three-year one, either sandwich or full-time, but students aiming at professional recognition require at least a further year of studies which may in some cases be part-time rather than sandwich or full-time.

4. It is important to remember that H.N.C. and H.N.D. courses are advanced courses in their own right and that the awards themselves are valuable and recognised for their worth. The schemes need not be designed to suit the requirements of a professional institution and, as the standards of these requirements are rising, more schemes are being planned independently of them. However, very many schemes, particularly H.N.D. ones, do have an eye,on professional exemptions, i.e., exemptions from the examinations of the institutions.

Broadly speaking, a subject requires at least two years' study at advanced, i.e., H.N.C. or H.N.D., level to reach the standard for professional exemption, and the institutions usually require passes in four such subjects, of which one or more may be compulsory and the remainder selected from groups of others.

A H.N.C. course of only three subjects each year can barely provide three exemptions and may give only two, so that at least a further year's study is needed to clear the Part II requirement. For complete membership requirements the student has then to study for Part III exemptions, or the direct Part III examination, which might take a further two years. The road to membership by H.N.C. supplementary courses is thus long and hard.

In a suitably-planned H.N.D. course, however, the student can easily satisfy the Part III requirements in the three-year course, and Part III in a further year. In addition, he has had a much broader course as a basis for his professional experience. As previously mentioned, the professional institutions themselves therefore advocate a H.N.D. course, as against a H.N.C. course, for students aiming at professional recognition.

5. There is appreciable variety in H.N.C. and H.N.D. courses in technical colleges, according to the size of the college, numbers of students, local industry and the type or character of local firms, the extent of daytime release etc., but to provide a wide range of subjects demands a corresponding range of expensive laboratories and equipment, and a greater number of highly qualified teachers. Particular demands of local industry, such as mass-production manufacture, mining, marine engineering, electrical power generation and supply, or electronic instrument manufacture may have important effect.

A college may run several courses in, say, Mechanical Engineering, under one approved scheme which covers the alternatives needed by different groups of students.

6. The following paragraphs outline typical H.N.C. and H.N.D. schemes in Mechanical Engineering, Electrical and Electronic Engineering, Production Engineering and Civil Engineering for a large college serving a number of interests in each field, in England and Wales. Corresponding courses in Scotland and Northern Ireland would not be significantly different, although there might be minor differences in such items as entry conditions, minimum time-content and conditions of award.

In England and Wales and Northern Ireland, a college might use the syllabuses and examinations of a Regional Examining Union but most colleges have their own syllabuses and internal examinations. In Scotland, however, all colleges use SANCAD syllabuses and external examinations (see Chapter IV, § C.1).

7. Approval of Schemes

Each H.N.C. and H.N.D. scheme must be submitted for prior approval to the appropriate Joint Committee. Schemes in Mechanical, Production and Aeronautical Engineering go to the tripartite Joint Committee for such schemes; schemes in Electrical and Electronic Engineering go to the corresponding Joint Committee and so on. As with O.N.C. and O.N.D. schemes, the Joint Committee must be satisfied about the accommodation and equipment of the college, the qualifications of the teachers, the standards of admission to the course, the curriculum and syllabuses, the time to be devoted to each subject and to laboratory work, and the examination arrangements.

8. Entry Conditions General

To qualify for entry to a H.N.C. course, a student must have gained an appropriate O.N.C. or O.N.D., or passed at Part II level one of a number of specified City and Guilds Technician courses. Direct entry is not normally permitted to a student without such previous technical studies, e.g., a G.C.E. "A" student, who may have to take all or part of the final year of an O.N.C. or O.N.D. course prior to entry.

Similar qualifications are required for entry to a H.N.D. course, except that prior technical studies are not essential and a G.C.E. "A" student with suitable passes may enter directly. The additional time provided in the H.N.D. course enables him to make good his deficiency in technical studies. A student who holds only City and Guilds Technicians' Certificates cannot enter a H.N.D. course until he has completed additional studies.

A. H.N.C. SCHEMES IN MECHANICAL ENGINEERING

1. With the formation of the new tripartite Joint Committee, the Rules for H.N.C. and H.N.D. schemes in Mechanical, Production and Aeronautical Engineering are under review, but it seems likely that in such items as minimum time-content and conditions of entry and awards they will be on similar lines to those adopted for schemes in Electrical and Electronic Engineering under their recently revised Rules, which are outlined in para. B.

2. The H.N.C. course is a part-time or block-release course of two years' duration, with a minimum of three subjects in each year. The present minimum time-content is a total of 360 hours over the two years but is likely to be increased under revised Rules. Continued Studies for Supplementary Certificates are included in the schemes.

3. Entry Conditions

For admission to the first year of the course, a student must have obtained:

(a) An O.N.C. or O.N.D. in Mechanical Engineering or an O.N.D. in Engineering; or

(b) An O.N.C. in Engineering with passes in Applied Mechanics and in either Applied Heat or Workshop Technology, and with Engineering Drawing completed at O.1 level; or

(c) The Mechanical Engineering Technician's Certificate, Parts I and II, (City and Guilds course no.293), together with the satisfactory completion of appropriate additional study arranged by the college; or

(d) Any qualifications deemed equivalent to any of the above by the Joint Committee.

4. Curriculum

The following curriculum is typical for the part-time day and evening, and block-release schemes of a large college offering many alternative subjects to suit local industry. A smaller variety would be offered in most colleges.

First Year (A.1)

Mathematics I
Strength of Materials and Theory of Machines
and ONE or TWO of the following:
Thermodynamics I
Principles of Engineering Production I
Metallurgy I
Mechanics of Fluids I
Electrotechnology I

Second Year (A.2)

Properties and Strength of Materials II
Theory of Machines II

and ONE or TWO of the following:

- Thermodynamics II
- Principles of Engineering Production II
- Metallurgy II
- Mechanics of Fluids II
- Electrotechnology II

Note: A student is not permitted to attempt stage II of a subject in the second year unless he has satisfactorily completed stage I of the corresponding subject in the first year.

H.N.C. AWARDED

Supplementary Studies

Third and Fourth Years (A.3 and A.4)

A selection from the following:

- Any subject of the second year not previously completed
- Theory of Structures
- Steam Engineering
- Internal Combustion Engineering
- Engineering Production
- Hydraulic Engineering
- Industrial Administration
- Control Engineering
- Work Study

Note: The above by no means exhaust the variety of permissible subjects.

5. Conditions for the Award of H.N.C.

(a) A candidate must have attended for not less than 60 per cent of the possible attendances in each year of the course.

(b) He must have qualified in each prescribed subject in the examinations in each year.

(c) He must have reached the qualifying mark in his subjects each year for homework, classwork and laboratory work where such marks are to be awarded under the scheme.

(d) The award is based on the final examination mark and the qualifying marks under (c) above in the final year.

(e) A distinction in any subject may be awarded to a successful candidate who gains not less than 85 per cent of the possible marks in the subject.

(f) A student who qualifies in approved subjects subsequent to successful completion of the course is awarded Supplementary Certificates for attachment to the H.N.C. These subjects may also carry a Distinction.

6. The system of assessment of examination papers, of the marking and moderation of scripts, and the issue of awards are the same as for the O.N.C., outlined in Chapter II, § G.2.

B. H.N.C. SCHEMES IN ELECTRICAL AND ELECTRONIC ENGINEERING

1. The Rules for H.N.C.s. and H.N.D.s. in Electrical and Electronic Engineering have recently been revised. They thus reflect developments that have occurred in the pattern of education for engineering technicians. The H.N.C. course is still a part-time or block-release course of two years' duration but now requires a minimum of 240 hours' study for the minimum three technical subjects in each year and additional time prorata for any further technical subjects. General Studies (non-technical) should be included, preferably of about 60 hours each year, where time affords but this is not expected in evening-only courses. Supplementary Certificates are awarded for approved continued studies.

2. Entry Conditions

For admission to the first year of the course, a student must have obtained:

(a) An O.N.C. or O.N.D. in Electrical Engineering or an O.N.D. in Engineering; or

(b) An O.N.C. in Engineering with passes in Electrical Engineering (Principles) or in two electrical engineering subjects; or

(c) A qualification deemed equivalent to any of the above by the Joint Committee; or

(d) One of the following City and Guilds Part II Technicians' Certificates together with the satisfactory completion of additional study arranged by the college:

Telecommunication Technician's Certificate (No.49)
Electrical Installation Work Course "C" Certificate (No.51c)
Electrical Technician's Certificate (No.57)

3. Curriculum

For the award of H.N.C., the Joint Committee requires a student. It take at least 5 electrical/electronic subjects distributed over the whole period of studies as follows.

	Electrical/electronic subjects required	
	(Either)	(or)
O.N.C.		
1st year	-	-
2nd year	1	2
H.N.C.		
1st year	2	1
2nd year	2	2

College schemes usually cater for this.

The following curriculum covers a number of part-time day and evening, and block-release courses that might be offered under one or more H.N.C. schemes in a large college to suit the varied requirements of students in local industry. It caters broadly for two groups, viz.:

(a) Those concerned with "heavy-current" subjects such as the generation, supply and utilisation of electrical power;

(b) Those concerned with "light-current" subjects such as electronics, electrical measurements and communications.

First Year (A.1)

Mathematics I
Electrotechnology I
General Studies
and ONE from the following:
Electrical Power I
Electrical Machines I
Electronics I
and the OPTIONAL ADDITION of:
Engineering Physics I or Thermodynamics I

Second Year (A.2)

General Studies
and THREE or FOUR from the following:
Mathematics II
Electrical Power II
Electrical Machines II
Utilisation of Electrical Plant
Electronics II
Measurement and Control Engineering
Communications Engineering
and the OPTIONAL ADDITION of:
Engineering Physics II or Thermodynamics II

H.N.C. AWARDED

Supplementary Studies
Third and Fourth Years (A.3 and A.4)

A selection from the following:

Any subject of the second year not previously completed.
A more advanced study of any of the subjects of the second year and/or additional subjects of a specialist nature, such as the following:
Mathematics
Advanced Electrical Engineering
Electrical power
Electrical Machines
Electricity Supply
Electrical Measurements
Control Engineering
Electronics
Line Communication
Radio Communication
Television Engineering
Illumination Engineering

4. Conditions for the Award of H.N.C.

(a) A candidate must have attended for not less than two-thirds of the prescribed time in each subject.

(b) Promotion from the first to the second year is at the discretion of the Principal.

(c) The candidate must have qualified in the final examination for each of the three subjects required under the scheme.

(d) He must have reached the qualifying marks in his subjects in the final year for homework, classwork and laboratory work as required under the scheme.

(e) A Distinction in any subject may be awarded to a successful candidate who gains not less than 85 per cent of the possible marks in the subject.

(f) A student who qualifies in approved subjects subsequent to successful completion of the course is awarded a Supplementary Certificate for attachment to the H.N.C. These subjects may also carry Distinction.

5. The system of assessment, marking and moderation, and the issue of awards is the same as that for the H.N.C. in Mechanical Engineering.

C. H.N.C. SCHEMES IN PRODUCTION ENGINEERING

1. The Rules for H.N.C. and H.N.D. schemes in Production Engineering are under review and it seems likely they will be on similar lines to the recently revised ones for Electrical and Electronic Engineering in items such as minimum time-content and conditions of entry and awards.

2. The H.N.C. course is again a part-time or block-release course of two years' duration, with a minimum of three subjects in each year, a present minimum total time-content of 360 hours, and the award of Supplementary Certificates for approved continued studies.

3. Entry Conditions

These are the same as for the H.N.C. in Mechanical Engineering (see para. A.3) except that the O.N.C. or O.N.D. entrant must have qualified in the subject of Workshop Technology as well as taken Engineering Drawing to O.1 level in the previous course.

4. Curriculum

The following curriculum is typical for the part-time day and evening, and block-release schemes of a large college offering many alternative subjects to suit local needs.

First Year (A.1)

Mathematics I
Strength of Materials and Theory of Machines
and ONE or TWO of the following:
Advanced Production Process
Metallurgy I
Electrotechnology I
Applied Physics I

Second Year (A.2)

Theory of Machine Tools II
Metrology II
and ONE or TWO of the following:
Metallurgy II
Electrotechnology II
Tool Design
Applied Physics II
Mathematics II
Advanced Applied Mechanics.

Note: As in other H.N.C.s., stage II of a subject cannot be attempted until completion of the relevant stage I.

H.N.C. AWARDED

Supplementary Studies
Third and Fourth Years (A.2 and A.4)

A selection from the following:
Any subject of the second year not previously completed

Tool Design II
Production Metallurgy
Control Engineering
Process Study and Work Study

Industrial Management
Management of Production
Management of Men

Note: There are also other permissible subjects.

5. Conditions for the Award of H.N.C.

These are the same as for the H.N.C. in Mechanical Engineering (see para. A.5).

6. The system of assessment, marking and moderation, and the issue of awards is the same as for other H.N.C.s.

7. Second Higher National Certificates

The Joint Committees, and also the professional institutions, are each prepared to give credit to a student for subjects of separate H.N.C.s. which correspond, e.g., Metallurgy in a Mechanical course would be accepted in lieu of Metallurgy in a Production course and vice versa. It is thus possible by suitable selection of subjects for a student who holds a H.N.C. in Mechanical Engineering to gain a second H.N.C. in Production Engineering by a single further year of study, and vice versa. Advantage is commonly taken of this facility.

D. H.N.C. SCHEMES IN CIVIL ENGINEERING

1. This H.N.C. is a particularly interesting one in that it has been revised to be, perhaps more than any other, a higher technician certificate.

2. Like the other H.N.C.s, it is a part-time or block release course of 2 years' duration, but it requires 4 subjects to be taken in each year, with a minimum of 240 hours per year for the technical subjects, plus about 60 hours per session for general studies.

3. Entry Conditions

Students may enter if they have an O.N.C. in Engineering, including passes in Materials and Structures, and Surveying; or an O.N.C. in Construction, including passes at the 0.2 level in Mathematics and in Materials and Structures; or any qualification deemed equivalent by the J Joint Committee.

4. Curriculum

The recommended course structure is as follows:

First Year (A.1)

Mathematics I
Theory of Structures I
Soil Mechanics I
Civil Engineering Construction I

Second Year (A.2)

Hydraulics I
Theory of Structures II
Civil Engineering Construction II
and ONE or more from:
Engineering Quantities
Mathematics II
Structural Design and Detailing

H.N.C. AWARDED

Supplementary Studies
Third and Fourth Years (A.3. and A.4.)

A selection from the following:

- Any subject of the second year not previously completed.
- Hydraulics II
- Soil Mechanics II
- Structural Design and Detailing II
- Theory of Structures III
- Surveying

5. Conditions for the Award of H.N.C.

These are broadly the same as for the H.N.C. in Mechanical Engineering (see para. A.5), except that the minimum attendance requirement is 60 per cent of the prescribed time, and that four assessed subjects must be examined in the A.2 year, the minimum qualification for a pass being success in the first three listed.

6. The system of assessment marking and moderation and the issue of awards is the same as for other H.N.C.s,

E. HIGHER NATIONAL DIPLOMA SCHEMES IN MECHANICAL ENGINEERING

1. The H.N.D. course is a sandwich or full-time course of three years' duration and with a minimum of five subjects in each year, though it is usual to study more than this. The award is given on five final-stage subjects, of which at least two are generally compulsory and the remainder alternative where more than five subjects are offered. Some subjects, e.g., General Studies, may not count for the award.

No minimum time-content is prescribed under present Rules but the time-content is usually not less than 720 hours in each year. Continued studies for Supplementary Certificates are shown in the scheme.

2. Entry Conditions

These are similar to those of the H.N.C. (see para. A.3) except that

(a) The O.N.C. or O.N.D. entrant is generally expected to have reached the "credit" standard of pass in the main subjects of his previous course and

(b) Direct entry is permitted to a student who holds the G.C.E. in five subjects including Mathematics and Physics, with one of these two passed at "A" level and the other studied to "A" level.

(c) Direct entry is not permitted to a student who holds only City and Guilds Technicians' Certificates.

3. Curriculum

As in the H.N.C., a large college will offer a variety of alternative subjects to suit local needs and a typical scheme is given below. This example caters for three distinct groups of students, viz:

(a) Those wanting a thermodynamics bias

(b) Those concerned with engineering production and manufacture

(c) Those concerned with aircraft.

First Year (D.1)

Mathematics I
Physics
Applied Mechanics
Applied Heat
Workshop Technology
Electrical Engineering (Principles)
Engineering Drawing and Design
General Studies

Second Year (D.2)

Mathematics II
Strength of Materials and Theory of Structures I
Theory of Machines I
Thermodynamics I
General Studies

and TWO only from the following:

Electrotechnology I
Mechanics of Fluids I
Metallurgy I
Principles of Engineering Production I

Third Year (D.3)

Mathematics III
Strength of Materials II
Theory of Machines II
General Studies

at least ONE from the following:

Thermodynamics II
Principles of Engineering Production II
Theory of Structures II

and ONE or TWO from the following:

Mechanics of Fluids II
Metallurgy II
Electrotechnology II
Aircraft Structures
Industrial Administration A

Not more than seven subjects may be studied in the final year.

For the award of a Diploma, a student must qualify in Strength of Materials II, Theory of Machines II, and any other three subjects except General Studies and Industrial Administration A.

H.N.D. AWARDED

Supplementary Studies
Fourth Year (D.4)

A selection from the following:
Any subject of the third year not previously completed

Industrial Administration B
Internal Combustion Engineering
Automobile Engineering
Engineering Production
Hydraulic Engineering
Control Engineering
Work Study

4. Conditions for the Award of H.N.D.

These are similar to those of the H.N.C. (see para. A.5) except that a candidate must qualify in five subjects as specified in the approved scheme.

5. The system of assessment, marking and moderation, and the issue of awards is the same as for the H.N.C.

F. HIGHER NATIONAL DIPLOMA SCHEMES IN ELECTRICAL AND ELECTRONIC ENGINEERING

1. The H.N.D. course is again a sandwich or full-time one of three years' duration and with a minimum of five technical subjects in the final year, though more are usually studied. General Studies should be included in each year, preferably about 90 hours a year. The award is given on five final stage technical subjects and one or more may be compulsory where more than five are studied.

No minimum time-content is prescribed but again the content is usually not less than 720 hours a year. Supplementary Certificate subjects are shown on the scheme.

2. Entry Conditions

Students admitted to the first year of the course must possess one of the following qualifications:

(a) An O.N.C. or O.N.D. in Electrical Engineering with "credit" passes in main subjects.

(b) An O.N.C. or O.N.D. in Engineering with "credit" passes in Mathematics and in main electrical engineering subjects.

(c) A G.C.E. in five subjects including Mathematics and Physics, with one of these two passed at "A" level and the other studied to "A" level.

(d) A qualification deemed equivalent to any of the above by the Joint Committee.

3. Curriculum

As in the H.N.C., a large college will offer a variety of subjects to suit local needs and a typical scheme is given below. This again caters for the two main groups of "heavy-current" and "light-current" subjects.

First Year (D.1)

Mathematics I
Physics
Applied Mechanics I
Electrotechnology I
Engineering Drawing
Applied Heat
General Studies

Second Year (D.2)

Mathematics II
Applied Mechanics II
Engineering Physics I or Thermodynamics I
Electrotechnology II

Electrical Power I or Electrical Machines I
Electronics I
General Studies

Third Year (D.3)

Mathematics III
Electrotechnology III
Engineering Physics II or Thermodynamics II
General Studies

and at least TWO from the following:

Electrical Power II or Electrical Machines II
Utilisation of Electrical Plant
Electronics II
Measurement and Control Engineering
Communications Engineering

For the award of a Diploma, a student must qualify in Mathematics III, Electrotechnology III, Engineering Physics II or Thermodynamics II, and two other subjects except General Studies.

H.N.D. AWARDED

Supplementary Studies
Fourth Year (D.4)

A selection from the following:

Any subject of the third year not previously completed.
A more advanced study of any of the subjects of the third year and/or additional subjects of a specialist nature, such as the following:
Advanced Electrical Engineering
Electrical Power
Electrical Machines
Electricity Supply

Electronic Engineering
Electrical Measurements
Control Engineering
Line Communication
Radio Communication
Television Engineering
Illumination Engineering

4. Conditions for the Award of H.N.D.

These are the same as for the H.N.C. in Electrical and Electronic Engineering (see para. B.4.) except that the candidate must have attended for not less than three-quarters of the prescribed time in each subject.

5. The system of assessment, marking and moderation, and the issue of awards is the same as for other H.N.D.s.

G. HIGHER NATIONAL DIPLOMA SCHEMES IN PRODUCTION ENGINEERING

1. This again, is a sandwich or full-time course of three years' duration with a minimum of five technical subjects in the final year of which one or more may be compulsory when more than five are studied. Time-content is usually not less than 720 hours a year, though no minimum is prescribed. Some subjects, e.g., General Studies, may not count for the award.

2. Entry Conditions

These are similar to those of the H.N.C. (see para. C.3) except that

(a) The O.N.C. or O.N.D. entrant is generally expected to have "credit" passes in the main subjects of his previous course.

(b) Direct entry is permitted to a student who holds the G.C.E. in five subjects including Mathematics and Physics, with one of these two passed at "A" level and the other studied to "A" level.

(c) Direct entry is not permitted to the student who holds only City and Guilds Technician Certificates.

3. Curriculum

A large college will again offer a variety of subjects to suit local needs and a typical scheme is given below.

First Year (D.1)

Mathematics I
Applied Mechanics
Advanced Workshop Technology
Electrical Engineering (Principles)
Engineering Drawing and Design
Physics
Chemistry
General Studies

Second Year (D.2)

Mathematics and Statistics II
Advanced Applied Mechanics I
Theory of Machine Tools I
Metrology I
Metallurgy I
General Studies

and ONE from the following:

Tool Design I
Electrotechnology
Industrial Technology I

Third Year (D.3)

Mathematics and Statistics II
Advanced Applied Mechanics II

- Theory of Machine Tools II
- Metrology II
- Production Metallurgy II
- General Studies

and ONE from the following:

- Tool Design II
- Production Design
- Control Engineering II
- Industrial Technology II

Not more than seven subjects may be studied in the final year.

For the award of a Diploma, a student must qualify in Theory of Machine Tools II, in either Metrology II or Production Metallurgy II, and in any three other subjects except General Studies.

H.N.D. AWARDED

Supplementary Studies
Fourth Year (D.4)

A selection from the following:

- Any subject of the third year not previously completed
- Process Study and Work Study
- Factory Layout and Materials Handling
- Applied Statistics and Operational Research
- Industrial Management
- Management of Production
- Management of Men

4. Conditions for the Award of H.N.D.

These are similar to those of the H.N.C. (see para. C.5) except that a candidate must qualify in five subjects as specified in the approved scheme.

5. The system of assessment, marking and moderation, and the issue of awards is the same as for the H.N.C.

Chapter VI

THE MECHANICAL ENGINEERING TECHNICIANS' COURSE, CITY AND GUILDS NO.293

1. Although various patterns of technician course, mainly in specialist fields, had been provided by the City and Guilds for many years, the effective prototype for much of the recent development was the Electrical Technicians' Course, no.57, introduced in 1955. The Institution of Electrical Engineers had given an important lead by the identification of the functions of electrical technicians in industry and the determination of their educational and training requirements. The Institution invited the City and Guilds to prepare a scheme for part-time courses and related examinations for electrical technicians and gave valuable assistance in its development, and many of the principles on which technician courses are now based were established during this work. An outline of the Electrical Technicians' Couse is given in Chapter VII.

2. However, perhaps a better example of the trend of new technician courses is the Mechanical Engineering Technicians' Course, no.293, usually abbreviated to the M.E.T. course, 293.

The Government White Paper of 1961, "Better Opportunities in Technical Education" (see Chapter II, § G.4), was the outcome of deliberations extending over some years and set a new pattern of engineering and other courses for craftsmen, technicians and technologists. The City and Guilds Advisory Committee which formulated the M.E.T. course, introduced in the same year, was able to take advantage of this new concept and to plan the course in conformity with the new pattern. The course has been an outstanding success because of its sound structure and because it so well meets the needs of many types of technician. It has three stages, Parts I, II and III, the last also carrying the award of Full Technological Certificate, each of which is planned for part-time day or block-release studies.

The diagram on page 102 shows its overall structure.

3. (a) Part I. This is a two-year course of some 250 to 350 hours each year designed primarily for students in the initial stages of training in industry and providing a broad general basis common to all technicians in mechanical engineering. It has additionally seven optional supplementary subjects, each of single stage, e.g., Non-Metallic Materials and Power Production, which may be taken after Part I or with Part I where time affords. The purpose of these is to provide preparation for later specialisation in certain fields or a desirable addition for work in particular branches of industry.

(b) Part II. This is also a two-year course of some 250 to 350 hours each year but is no longer a common course, although it has a common core of subjects such as Engineering Science and Mathematics taken by all students. By the time they reach Part II, many students have already decided, and are being allocated to, the main field of technician work they intend to follow. Not all want to continue with the main stream in workshops or manufacture; some may be embarking on a career as a draughtsman; others may be going into plant maintenance and works services, or to testing and development, and so on. The course therefore offers branches in technological and associated studies to suit the main groups.

(c) Part III (F.T.C.). At this stage, some students will be adult and not readily able to obtain day-release so although the course is planned for shorter duration, a minimum of 310 hours, it normally takes two years where studies are evening-only. The specialisations of Part II are continued and developed to higher technician stage, but additional specialist branches such as Mechanical Engineering Inspection or Work Study are offered for the technician going forward in one of these fields.

4. By its extending range of specialist studies, the course becomes in fact a set of courses which embrace the main fields of technician activity in mechanical and production engineering and have, incidentally, replaced a number of previous specialist and limited courses at later stages.

The course is also in line with the industrial training of the technician, which has three stages: (a) a basic training in engineering workshop practice and an introduction to materials and processes; (b) experience in different types of work and different departments to give a broader appreciation of the whole; (c) specialisation in the selected field of work.

5. The course offers:

(a) An initial general foundation

(b) A comprehensive range of specialisms which can be matched with progressive industrial training.

(c) Close identification of fields of study and qualification with particular technician occupations.

(d) The balance of mathematics and science with technology and practice which is of such special importance to the technician.

(e) The inclusion of general, non-technical, studies to widen the technicians' outlook and interest, to assist him to establish sound standards and values, and to improve his ability in written and oral communication.

6. Because of their general suitability, Part I and Part III of the course have also been adopted as parts of other technician courses. For example, Part I is used as an entry qualification to the Instrument production Technician's Certificate Course, no.312, and some of its syllabuses are used in the Shipbuilding Technicians' Course, no.289, while the Aeronautical Engineering Practice Course, no.171, accepts several of the Part III courses for its own Part III and F.T.C.

7. The following paragraphs examine the structure of the course in detail.

A. THE M.E.T. PART I COURSE

1. The course is planned for a minimum total of 500 hours' part-time study over two years, but in block-release and sandwich courses a minimum of 650 hours of study is expected, including more laboratory and practical work. An evening-only course is normally spread over three years.

2. Entry Conditions

The Institute recommends the following entry qualifications:

Entry to Year I

(a) A five-year secondary school course (or a four-year one in Scotland) which has included in the final year Mathematics, a suitable science subject, and Technical Drawing or Metalwork.

(b) Satisfactory completion of the General Course in Engineering.

(c) Transfer, where appropriate, from the Mechanical Engineering Craft Practice Course (a parallel craft course for young apprentices) at the end of Part I.

Direct entry to Year II

(d) Satisfactory completion of the General Course in Engineering with passes in three subjects, including Workshop Processes.

(e) A minimum of three "O" level passes in the G.C.E. or S.C.E., including Mathematics, a suitable science subject and Engineering Drawing or Metalwork.

(f) Transfer, where appropriate, from the Mechanical Engineering Craft Practice course at the end of Part II.

3. Curriculum

The subjects in each of the course are as follows:

(i) Workshop Processes and Practice
(ii) Engineering Drawing and Materials
(iii) Engineering Science
(iv) Mathematics
(v) General Studies

The syllabuses are closely co-ordinated but that for General Studies is left to the college to devise, though guidance is given by the Institute.

The subject of Workshop Processes and Practice includes a Scheme of Practical Work in two parts, A and B. For part A, the syllabus sets out 23 workshop investigations and experiments, involving various techniques and processes, of which at least seven are to be done in each year. These are not "exercises" or test pieces in craft skill. In part B, students complete projects which combine operations such as those of part A, for which they may work in small groups. The scheme of Practical Work is regarded as laboratory work in Workshop Processes and each student must keep an individual record of his work.

In Engineering Science, some 50 per cent of the time is to be spent on experimental and demonstration work and the student is required to keep an individual record of his experimental work.

4. Examinations

(a) The examination at the end of the Part I course consists of three written papers, viz:

(i) Workshop Processes and Practice
(ii) Engineering Drawing and Materials
(iii) Engineering Science and Mathematics

The examination in General Studies is left entirely to the college to devise, but one copy of the college requirement must be sent to the Institute. As with the General Course in Engineering, it is considered that there is scope for much variation and experiment in this field and that colleges should be free to develop it in their own way (see Chapter III, § 3).

(b) The principal of the college is required to certify to the Institute that each candidate for the examination has:

- (i) Been selected for entry to the course on the basis recommended (see para. A.2).
- (ii) Satisfactorily completed the full course of study
- (iii) Completed a scheme of laboratory and practical work in Workshop Processes as prescribed (see para. A.3) and in Engineering Science, with satisfactory individual records of work.

5. Part I Supplementary Subjects

As stated in para. 3(a), these are single-stage subjects provided for specialist needs in certain fields. They are normally taken after completion of Part I but where time affords may be taken in the second year of Part I. They are as follows:

- (i) Non-Metallic Materials
- (ii) Electrical Theory and Practice
- (iii) Primary Processes A - Raw Materials
- (iv) Primary Processes B - Melting and Casting
- (v) Primary Processes C - Forming and Joining
- (vi) Power Production (Internal-combustion engines, steam power services, generator sets etc.).
- (vii) Basic Physics

B. THE M.E.T. PART II COURSE

1. The Part II course is planned for the same time-content and two-year duration as the Part I course.

2. Entry Conditions

The Institute recommends the following entry conditions:

(a) Satisfactory completion of the M.E.T. Part I course

(b) Possession of the O.N.C. or O.N.D. in Engineering, or Mechanical Engineering, with Workshop Technology as an assessed subject

(c) A course of study in Mechanical Engineering, including Workshop Technology, deemed equivalent by the Institute to (a) above.

3. Curricula

As stated previously, the M.E.T. course is designed at this stage to provide some degree of specialisation in main fields, to suit technician occupations, but the course continues on broad lines with a common basis of science and mathematics. The differenceslie in the technology and its associated subjects.

All students take the following common subjects:

(i) Engineering Science

(ii) Mathematics

(iii) General Studies

The various technologies are designated Special Technologies and each carries its own associated subject to suit the particular technology. Each also has its own optional supplementary subject of Applied Technology, a practical subject in which students are required to work on group and individual projects which they themselves plan, conduct and test. The subject is usually a single-stage one taken in the second year and is not examined by the Institute. The Special Technologies and their subjects are as follows:

(a) Workshop Technology

Subjects:

(iv) Workshop Technology I and II
(v) Engineering Construction and Materials I and II
(vi) Applied Technology (optional)

(b) Mechanical Engineering Drawing

(iv) Engineering Drawing I and II
(v) Processes and Materials I and II
(vi) Applied Technology (optional)

(c) Plant Maintenance and Works Services

(iv) Plant Maintenance and Works Services: Theory I and II
(v) Plant Maintenance and Works Services: Practice I and II
(vi) Applied Technology (optional)

(d) Testing and Development Technology

First Year:

(iv) Testing and Development Technology I
(v) Engineering Construction and Materials

Second Year:

(iv) and (v) Testing and Development
(vi) Applied Technology (optional)

(e) Control Systems Technology

First Year:

(iv) Control Systems Technology I
(v) Electrical Theory and Practice

Second Year:

(iv) and (v) Control Systems Technology II
(vi) Applied Technology (optional)

(f) Press Tool Technology

(iv) Press Tool Technology I and II
(v) Press Tool Construction and Materials I and II
(vi) Applied Technology (optional)

(g) Plastics Mould Making Technology

(iv) Plastics Mould Making Technology I and II
(v) Plastics Mould Making Construction and Materials I and II
(vi) Applied Technology (optional)

Syllabuses are closely co-ordinated but that for General Studies is again left to the college to devise. Appropriate laboratory and practical work is required and, in some cases, specimen schemes for it are given with the syllabuses. Each student is required to keep an individual record of such work.

4. Examinations

(a) The examination at the end of the Part II course consists of three written papers, viz:

(i) Engineering Science and Mathematics (common for all candidates)

(ii) (iii) Two papers for each Special Technology, appropriate to the subjects studied.

(b) The Principal of the college is required to certify that each candidate has:

(i) Satisfied the entry conditions for the course (see para. B.2)

(ii) Satisfactorily completed the full course of study

(iii) Completed a course of laboratory work in Engineering Science and a course of laboratory/practical work associated with his Special Technology and has satisfactory individual records of them.

(c) External Candidates

In exceptional circumstances and by approval of the City and Guilds of London Institute, an external candidate may be admitted to the Part II examination (but not to those of Parts I and III). An external candidate is one who for some valid reason has been unable to attend the relevant course at a technical college or approved establishment. Each application is decided on its individual merit. External candidates are not accepted overseas, but see para. D below.

C. THE M.E.T. PART III (F.T.C.) COURSE

1. In order to qualify for the Full Technological Certificate, a student must take a further course beyond the Part II stage. This may be in either (a) one of the technological subjects provided under Part III of the M.E.T. course or (b) in one of certain other Institute subjects of this level. These other subjects are at present (1965) limited to:

Work Study, no.195

Engineering Planning, Estimating and Costing, no.64.

2. Each of the technological subjects provided under Part III of the M.E.T. must have a minimum duration of 310 hours, including the separate,

related and compulsory subject of Applied Technology of minimum duration of 70 hours. As students at this stage are usually fairly mature, much of the work should be done in tutorial groups, taking advantage of the back-ground of experience of each student.

3. Entry Conditions

Since each of the technological subjects of Part III is intended for a specific category of student, conditions of entry vary slightly with the subject but are broadly as follows:

(a) Satisfactory completion of an appropriate Part II M.E.T. course

(b) Satisfactory completion of an appropriate Part II course in another approved subject such as Aeronautical Engineering Practice, no.171.

(c) Possession of an H.N.C. or H.N.D. in Mechanical, Production or Electrical Engineering, provided appropriate subjects have been studied.

(d) An examination qualification deemed equivalent by the Institute to one of the above.

Students entering under (c) or (d) above are not eligible for the award of F.T.C. since they have not previously gained a Part II Certificate.

4. Curricula

The technological subjects of Part III constitute with their own Applied Technology individual self-contained units. Several of them are a final stage of one of the Special Technologies of Part II but some cater for different specialist fields; as mentioned in Chapter VI § 3.

Syllabuses in the following subjects have been published:

(i) Engineering Production

(ii) Jig and Tool Design

(iii) Product Design
(iv) Plant Engineering
(v) Mechanical Engineering Inspection

Syllabuses in the following subjects have yet to be published:

(vi) Testing and Development Engineering
(vii) Control Systems Engineering
(viii) Mechanical and Thermal Treatment of Metals
(ix) Press Tool Design and Utilisation
(x) Plastics Mould Making Design and Utilisation

The compulsory Applied Technology for each subject is again a practical subject in which students are required to work on group and individual projects which they themselves plan, conduct and analyse or test. Applied Technology is not examined by the Institute but colleges are required to report on the various projects attempted and may be asked to submit some or all of them to the Institute for inspection.

5. Examinations

The examination at the end of the Part III course consists of two written papers concerned directly with the technological subject studied.

The Principal of the college is required to certify that each candidate has satisfied the conditions of entry to the course and satisfactorily completed the full course of study, including the appropriate Applied Technology.

D. OVERSEAS CANDIDATES, PARTS I, II AND III

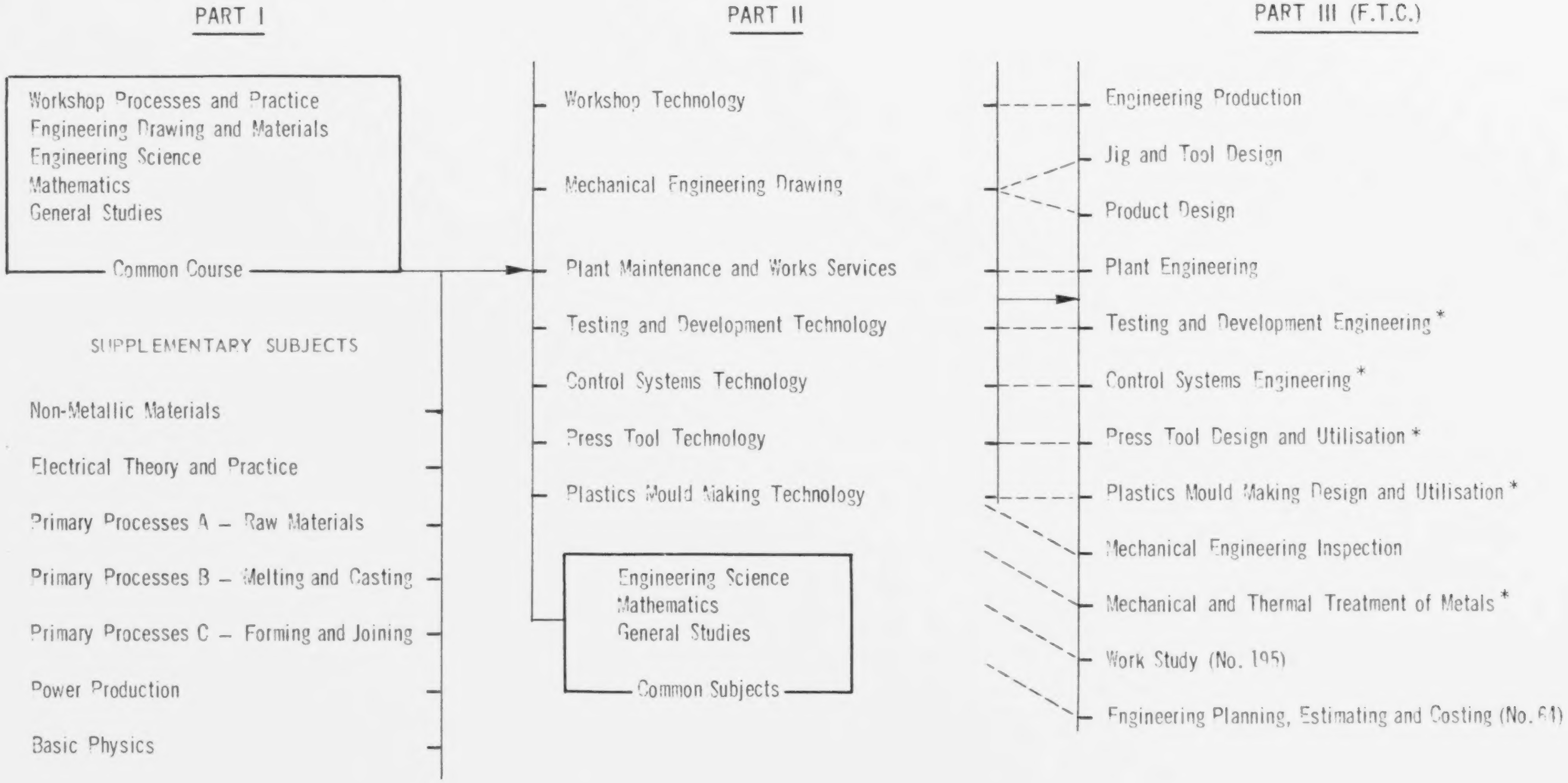
Under special regulations, technical colleges and similar establishments outside the United Kingdom can be approved for M.E.T. courses and students who have taken an approved course at one of them can be accepted for the relevant examination, which is usually conducted at a local centre. As stated in para. B.3 (c), external candidates, i.e., those who have not attended an approved course, cannot be accepted from overseas.

Overseas students attending courses in the United Kingdom are reated as United Kingdom students.

E. EXEMPTIONS AND RECOGNITION OF M.E.T. AWARDS BY OTHER BODIES

A number of professional and other bodies recognise appropriate M.E.T. Part II and Part III (F.T.C.). Certificates as satisfying the educational requirements for various grades of membership or for appointments and promotion at prescribed levels. Students with such awards may also enter some H.N.C. Engineering courses, subject to the completion of any necessary additional studies.

STRUCTURE OF THE MECHANICAL ENGINEERING TECHNICIANS' COURSE, No. 293


PART I
PART II
PART III (F.T.C.)
Workshop Processes and Practice
Engineering Drawing and Materials
Engineering Science
Mathematics
General Studies
Common Course
SUPPLEMENTARY SUBJECTS
Non-Metallic Materials
Electrical Theory and Practice
Primary Processes A – Raw Materials
Primary Processes B – Melting and Casting
Primary Processes C – Forming and Joining
Power Production
Basic Physics
Workshop Technology
Mechanical Engineering Drawing
Plant Maintenance and Works Services
Testing and Development Technology
Control Systems Technology
Press Tool Technology
Plastics Mould Making Technology
Engineering Science
Mathematics
General Studies
Common Subjects
Engineering Production
Jig and Tool Design
Product Design
Plant Engineering
Testing and Development Engineering *
Control Systems Engineering *
Press Tool Design and Utilisation *
Plastics Mould Making Design and Utilisation *
Mechanical Engineering Inspection
Mechanical and Thermal Treatment of Metals *
Work Study (No. 195)
Engineering Planning, Estimating and Costing (No. 61)

Students who have completed Part I may enter any Part II course.
Students who have completed Part II may enter any appropriate Part III course but the usual progression is indicated by the dotted lines.
* denotes Part III syllabuses yet to be published (August 1965).

Chapter VII

ELECTRICITY AND TELECOMMUNICATION COURSES OF THE CITY AND GUILDS

A. THE ELECTRICAL TECHNICIANS' COURSE, NO. 57

1. As mentioned in para. 25.1, the Electrical Technicians' Course was introduced in 1955 and was the precursor of the more recent technician courses in engineering. It is designed for technicians engaged in the design, draughting, manufacture, testing, operation and maintenance of electrical plant and equipment in one of the following branches of electrical engineering:

Plant and Machinery
Power Generation and Supply
Industrial Electronics

2. The course is planned for a duration of four years of part-time, block-release or sandwich studies. At the end of the second year, students take the examination for the Intermediate Certificate and at the end of the fourth, the Final examination for the award of the Electrical Technicians' Certificate. A further course in advanced techniques, normally of one year's duration, leads to the award of Endorsement Certificates and the Full Technological Certificate.

3. Entry Conditions

The Institute requires one of the following entry qualifications:

Entry to Year I

(a) A secondary school course up to the age of 16 and a standard in mathematics and science satisfactory to the Principal of the college;

(b) For a student who left secondary school before the age of 16 the successful completion of a suitable preliminary technical course;

(c) Satisfactory completion of a two-year course at a secondary technical school after the age of 13.

Direct Entry to Year II

(d) Satisfactory completion of the General Course in Engineering with passes in Mathematics, Engineering Science and one other subject;

(e) Transfer, where appropriate, from an electrical craft course at the Intermediate stage;

(f) A qualification considered by the Principal to be superior to the above.

4. Curriculum

The subjects of the first two years are:

Electrical Engineering Principles
Engineering Materials and Drawing

Practical Mathematics
Technical Reports
Workshop Practice

The subjects of the third and fourth years are as follows:

Third Year

Electrical Principles
Practical Mathematics
Electrical Power Equipment or Industrial Electronics

Fourth Year

Electrical Power Equipment or Industrial Electronics
Testing Methods (Power) or Testing Methods (Electronics)
  or Draughting Principles
* A Special Technique

* The syllabus and examination paper in Special Techniques are normally devised by the college to suit local needs and have to be submitted to the Institute for prior approval.

Endorsement Courses

These courses are divided into two groups, viz.:

Group A: General Techniques
Group B: Special Applications

Students are required to take one Group A subject and a related Group B subject. The Group A subjects are as follows:

Instrumentation
Industrial Electronics
Industrial Control Systems
Generation of Electrical Energy
Transmission and Distribution of Electrical Energy
Utilisation of Electrical Energy

Syllabuses and examination papers for Group B subjects, which are not nominated, are devised by the college to illustrate specialist applications of the General Techniques studied in Group A, in accordance with local needs, and have to be submitted to the Institute for prior approval.

5. Examinations

The Intermediate examination has three written papers, viz.:

(i) Electrical Engineering Principles
(ii) Practical Mathematics
(iii) Engineering Materials and Drawing

The Final examination, for the award of the Electrical Technician's Certificate, provides alternative papers, viz.:

(i) Electrical Power Equipment or Industrial Electronics
(ii) Testing Methods (Power) or Testing Methods (Electronics) or Draughting Principles
(iii) A Special Technique.

The Endorsement examination, for the award of Endorsement Certificates, has two written papers, viz.:

(i) A Group A subject, as listed above
(ii) A related and approved Group B subject.

6. Full Technological Certificate

For the award of the F.T.C., a candidate must have gained the Electrical Technician's Certificate and Endorsement Certificates in one Group A and at least one Group B subject.

B. THE TELECOMMUNICATION TECHNICIANS' COURSE, NO. 49

1. The Telecommunication Technicians' Course is designed for technicians employed by the Post Office and firms in the radio and telecommunication industry who are engaged in the manufacture, maintenance and operation of telecommunication apparatus. It is planned as a four-year course of part-time, block-release or sandwich studies, and is unusual in that the Institute offers a written examination and subject certificate in each of the subjects in each year of the course, and individual subjects may be taken. A 'grouped' examination must be taken,

however, for the award of the Intermediate Certificate at the end of the second year and of the Telecommunication Technician's Certificate at the end of the fourth.

More advanced studies in the principles of telecommunication engineering and of the special branches of the subject are provided by the Supplementary Studies in Telecommunication and Electronics Course, no. 300, and lead to the award of a Full Technological Certificate in the appropriate branch of telecommunication.

2. Curriculum

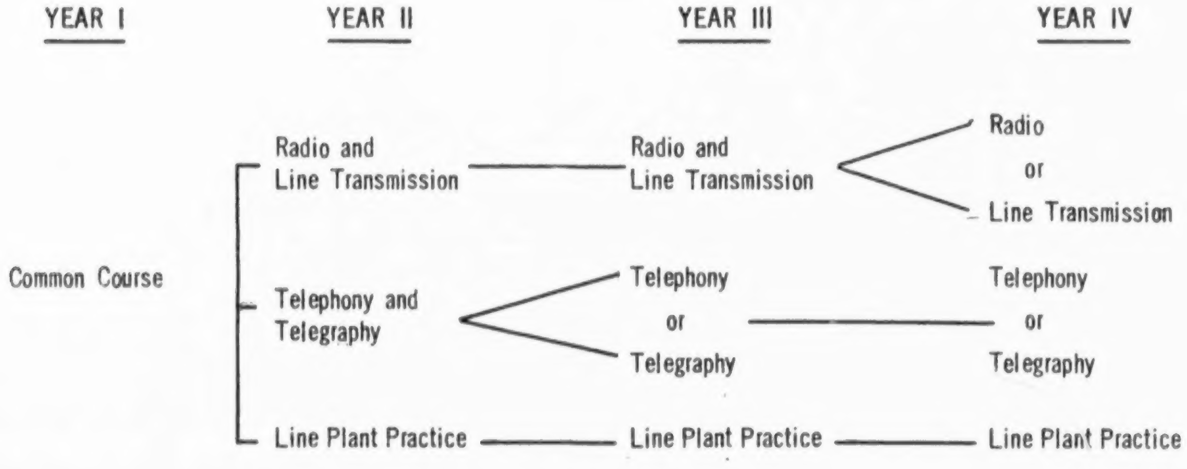
The course bears some similarity to the Mecanical Engineering Technicians'Course in that it affords branches to suit particular telecommunication technician occupations, in the mechanical field. The first year is common to all branches and its subjects are:

Practical Mathematics
Engineering Science
Engineering Drawing and/or Elementary Telecommunication Practice.

In the second, third and fourth years all students take the common subjects of

Mathematics
Telecommunication Principles

together with one of the special subjects according to their need. The arrangement of these special subjects is as follows:


YEAR I
YEAR II
YEAR III
YEAR IV
Common Course
Radio and Line Transmission
Radio and Line Transmission
Radio
or
Line Transmission
Telephony and Telegraphy
Telephony
or
Telegraphy
Telephony
or
Telegraphy
Line Plant Practice
Line Plant Practice
Line Plant Practice

Thus, there are three branches in the second year, Radio and Line Transmission, Telephony and Telegraphy, and Line Practice. In the third year, the second of these divides into separate subjects and, in the fourth year, the first of them divides similarly. In the final, fourth-year, examination, the student may be taking any one of the five separate special subjects shown.

3. Examinations

For the award of the Intermediate Telecommunication Certificate at the end of the second year or the Telecommunication Technician's Certificate at the end of the fourth, a candidate must have taken a grouped examination of the two common subjects, Mathematics and Telecommunication Priciples, and one of the appropriate special subjects. External andidates who have been unable to attend a college course may be accepted for the examinations but are then awarded External Certificates.

Certain exemptions in Mathematics are given to students who are taking or have gained an O.N.C. or O.N.D. in Engineering or Applied Physics.

4. Full Technological Certificate

For the award of F.T.C., a candidate must have gained the Telecommunication Technician's Certificate and at least two of the Supplementary Certificates of the Supplementary Studies course no. 300 (see para. C.3 below).

C. SUPPLEMENTARY STUDIES IN TELECOMMUNICATION AND ELECTRONICS, CITY AND GUILDS COURSE NO. 300

1. The Supplementary Studies in Telecommunication and Electronics are designed for advanced students of Telecommunication, Electrical

Engineering or Physics who wish to further their studies in special applications of telecommunication and electronics, and not merely for those who have completed the Telecommunication Technicians' Course, no. 49.

Each subject with its examination is a separate entity but a combination of subjects may be studied. The course normally lasts for one year and, since students are often adult, is commonly an evening-only one.

2. Entry Conditions

No entry conditions are stipulated but entry is always subject to the direction of the Principal of the college. Possession of one of the following qualifications is a usual requirement:

(a) A university Degree, a Diploma in Technology, a H.N.D. or H.N.C. with telecommunication engineering or electronics as an integral part or as a later study;

(b) A similar qualification in Physics or Applied Physics;

(c) A Telecommunication Technician's Certificate.

3. Curricula and Examinations

Syllabuses and examinations leading to the award of Supplementary Certificates in the following subjects are offered:

Advanced Telecommunication and Electronic Principles I, II and III
Communication Radio I and II
Basic Microwave Techniques
Microwave Radio-Relay Systems
Radar and Radio-Navigational Aids
Advanced Line Transmission I and II
Sound Broadcasting
Television Broadcasting I and II
Advanced Telephony I and II
Digital Computers
Analogue Computers.

Chapter VIII

OTHER ENGINEERING TECHNICIAN COURSES OF THE CITY AND GUILDS

The following paragraphs give an outline of some of the other engineering technician courses of the City and Guilds.

A. COURSE IN MOTOR VEHICLE TECHNICIANS' WORK, NO. 170

1. This is an example of an "end-on" technician course since it follows either or both of the craft courses, Motor Vehicle Mechanics' Work, no. 168, or Motor Vehicle Electricians' Work, no. 169, each of which has required three years of part-time study. It carries the award of Full Technological Certificate.

The Technicians' course deals with the basic principles governing the design and construction of vehicles, the diagnosis and rectification of faults in all parts of the vehicle, and testing and analysis of the performance of vehicles after repair or modification. It is intended for students aiming at senior technical and administrative posts in vehicle repair workshops and garages.

2. The course is planned for two years of part-time or block-release study of not less than 180 hours each year, including a minimum of 20 hours on laboratory work in Science and 60 hours in Workshop Practice. Much more than 180 hours is normally given.

The subjects of each year are:

Motor Vehicle Technology
Science, including Mathematics
Workshop Practice.

The syllabuses are co-ordinated, that for Science being directed to the scientific principles of the vehicle and that for Workshop Practice being concerned largely with more advanced operations.

3. The examination consists of two written papers in Motor Vehicle Technicians' Work which range over the whole field of study. External candidates are accepted after individual approval of their case by the Institute of the Motor Industry and recommendation to the City and Guilds. For the award of F.T.C., the candidate must also have gained the Certificate in either Motor Vehicle Mechanics' Work or Motor Vehicle Electricians' Work in the earlier course.

The examination is recognised for exemptions from some of the membership examinations of the Institute of the Motor Industry and the Institute of Road Transport Engineers.

B. COURSES IN AERONAUTICAL ENGINEERING PRACTICE, NO. 171, AND AIRCRAFT ELECTRICAL PRACTICE, NO. 175

1. These are parallel courses for students employed in the aircraft industry whose objectives are positions of responsibility based on practical training and experience. They cover various aspects of production and maintenance of aircraft and are designed on the basis that local aircraft companies and organisations will co-operate with the college in providing the necessary facilities outside the scope of the college itself, e.g., in study and work on actual aircraft.

2. The courses each have three stages, Parts I, II and III (F.T.C.). Parts I and II are planned as two-year part-time, block-release or sandwich courses, each with a minimum total of 500 hours of part-time study or 650 hours of block-release or sandwich study. The Part III course is planned for a minimum total of 250 hours and can often be covered in one year.

3. Curricula

The subjects of the Part I courses are as follows:

Course 171

Engineering Science with Calculations
Engineering Drawing
Workshop Technology and Practice
Airframe and Power Plant Equipment and Installation
Scheme of Practical Work
General Studies

Course 175

Engineering Science with Calculations
Electrotechnology
Workshop Technology, Practice and Sketching
Aircraft Electrical Equipment and Installation
Scheme of Practical Work
General Studies

Part II of the 171 course has special subjects to meet the different needs of students, in airframes or power plant, and in production or maintenance, since these four are the responsibilities of different groups.

The full list of subjects is a follows:

(i) Engineering Science and Calculations;
(ii) Engineering Drawing and Planning;
(iii) Aeronautical Engineering Practice (General);
(iv) Inspection, Overhaul and Modification;
(v) General Studies;

(vi) Not less than ONE of:
Production - Power Plant
Production - Airframe
Maintenance - Power Plant
Maintenance - Airframe
(vii) Practical Work - to correspond with selection from subject (vi)

Where time permits, more than one of the special subjects of (vi) and (vii) above may be studied in the course. Alternatively, further special subjects may be studied as supplementary subjects after completion of Part II.

Part II of the 175 course has the following subjects:

Electrical Engineering Science with Calculations
Electrotechnology
Aircraft Electrical Installations
Practical Work
General Studies

The subjects for Part III are at present under consideration but some of the Part III courses of the Mechanical Engineering Technicians' Course, no. 293, have already been accepted.

4. Examinations

The Part I examination consists of three written papers covering the subjects of the course except for General Studies, which is examined internally by the college.

The Part II examination for the 171 course has a minimum of three papers of which two are common, viz.:

(i) Engineering Science, Calculation and Drawing;

(ii) Aeronautical Engineering Practice
  (a) General
  (b) Inspection, Overhaul and Modification.

The third paper is one of four alternatives provided for the four special subjects. Additional special-subject papers may be taken with the Part II examination or as supplementary papers later.

The Part II examination for the 175 course has three papers covering the subjects of the course, except General Studies.

The Part III examinations are at present those of the M.E.T. course which have been approved for the purposes of the 171 and 175 courses.

For the award of the F.T.C., a candidate must have qualified at both Part II and Part III stages.

C. COURSE FOR THE INDUSTRIAL MEASUREMENT AND CONTROL TECHNICIANS' CERTIFICATE, NO. 310

1. This is an "ab initio" technician course recently introduced and designed for technicians employed on industrial measurement and control who aim at positions of responsibility in these fields. The course has three stages, Parts I, II and III, the last leading to the award of Full Technological Certificate.

Part I provides a broad understanding of the basic principles of industrial measurement and control. In Part II, work on general instrument technology continues and is extended to automatic control and to electrical and electronic instrumentation of equipment. Part III deals with the special applications of measurement of composition and of remote indication and control.

2. The courses are planned for part-time, block-release and sandwich studies, with minimum time-contents similar to those of the M.E.T., no. 293 course, and include General Studies at all stages.

The entry conditions to the Part I course are similar to those of the M.E.T. course, while entry to Parts II and III is normally based on satisfactory completion of the previous stage.

The subjects of the Part I course are as follows:

Workshop Processes and Drawing
Mathematics
Instrument Science

Instrument Technology

Those of the Part II course are:

Instrument Science
Mathematics
Instrument Technology (General)
Automatic Control
Electronic and Electrical Instrumentation

The Part III syllabuses are in preparation.

3. The full series of examinations is as follows:

Part I

Workshop Processes and Drawing
Instrument Science
Instrument Technology

Part II

Instrument Technology (General)
Automatic Control
Electronic and Electrical Instrumentation

Part III

Measurements of Composition
Remote Indication and Control

External candidates may be approved by the Institute, each case being considered on its merits. Overseas candidates are accepted only if they have attended a course approved by the Institute.

Successful candidates who have passed the appropriate complete examination at one sitting are awarded the Industrial Measurement and Control Technicians' Certificate Part I, Part II and Part III.

For the award of the F.T.C., the candidate must have qualified in all three Parts of the course.

D. ELECTRICAL INSTALLATION WORK COURSE 'C', NO. 51

1. This is an example of an "end-on" technician course which follows successful completion of a two-stage craft course, Electrical Installation Work Course 'A' and Course 'B', and is intended for the student who is aiming at a responsible position in the planning and supervision of general types of electrical installation work.

The course is planned as a part-time, block-release or sandwich course of two years' duration and a minimum total of 330 hours, though more than this is usual. Entry is normally based on satisfactory completion of the previous Course 'B'. The course leads to the award of a Full Technological Certificate.

2. The subjects of the course are:

Installation Work and Regulations
Practical Work
Electrical Science
Calculations

The student is expected to have a thorough working knowledge of the current Institution of Electrical Engineers' Regulations for the Electrical Equipment of Buildings and a knowledge of the Electricity (Factory Act) Special Regulations and the Electric Supply Regulations.

3. The examination consists of two written papers, viz.:

Installation Work and Regulations
Electrical Science, Calculations and Sketching.

The college is also required to submit an appraisal of the practical and laboratory work of each internal candidate throughout the course, and this Appraisal of Course Work is taken into account in the final marks awarded. The name of the college is recorded on the candidate's Certificate. Successful candidates are awarded the Course 'C' Certificate in Electrical Installation Work, and for the award of the F.T.C. must also have previously obtained the Electricians' Certificate for successful completion of Course 'B'.

External candidates may be approved by the Institute, each case being considered on its merits, but their Certificates do not record a college name.

E. NUMBERS OF CANDIDATES TAKING CITY AND GUILDS EXAMINATIONS IN ENGINEERING TECHNICIAN COURSES IN 1963 AND 1964

Appendix 9 gives the numbers of United Kingdom and Overseas candidates for City and Guilds examinations in the various engineering technician courses dealt with in Chapters VI, VII and VIII above, for the years 1963 and 1964.

Chapter IX

THE INDUSTRIAL TRAINING OF ENGINEERING TECHNICIANS

A. TYPES OF APPRENTICESHIP

1. In considering the industrial training of engineering technicians, it seems advisable first to indicate the main types of apprenticeship in the industry. The distinctions between craftsmen, technicians and technologists were briefly discussed in Chapter II, para. D.1 and it is undoubtedly true that a craft apprentice or craftsman often becomes a technician and that a higher technician sometimes becomes a technologist. It is possible, given the necessary ability, training and effort, to rise from one group to the next.

Although it is becoming more and more common for the technician to be trained as such"ab initio", this training can demand a fairly comprehensive experience of workshop techniques and processes, involving some degree of craft skill.

2. The amount of craft experience required by the technician can have wide variation. One who is being trained in production engineering for, say, production planning must have experience in many operations and processes. He must be familiar with the uses of all kinds of machine tools and their machining rates, in welding and other joining processes by hand and machine, in fitting and assembly, in inspection etc., and

preferably have had some drawing office experience. He may therefore spend some years in preliminary training. On the other hand, a technician in the electronic engineering industry may need little basic training in the use of tools and machines, and be able to go directly on to technician work at an early stage.

3. In the United Kingdom, four main types of engineering apprenticeships can be distinguished and many of the larger and more progressive firms will offer all of them. They are as follows:

(a) Craft Apprenticeship

This usually starts at about 16 years of age and lasts for a prescribed number of years, e.g., four to five years, the tendency now being to reduce the period where the eventual requirement and scheme of training allow. The apprentice is usually given a period of basic training, up to a year, in an Apprentice Training Department, followed by some varied experience in production workshops, and is then selected for a particular craft, in consultation with his parents and supervisors. Apprentices showing special promise may be transferred to technician apprenticeship.

(b) Technician Apprenticeship

This starts at 16 to 17 years of age and demands a higher level of general education on entry, prescribed levels varying according to the firm and the type of technician in prospect. A firm may require the boy to have a minimum number of passes in suitable subjects of the G.C.E. or an equivalent, for example. The entrant usually completes basic training in an Apprentice's Training department and is then given experience in various types of work in different departments, often including a period in the drawing office. His final allocation to a particular field may not occur for some time and may depend on his progress in technical studies as well as his aptitude and performance with the firm. Some firms train technician apprentices over a broad field so that they can handle a number of specialisms and take wider responsibilities.

(c) Student Apprenticeship

Many firms take as student apprentices selected boys of about 18 years of age who have completed higher secondary education and may well have satisfied entry conditions to a university but have preferred instead to enter industry at that point. Such boys are at least potential higher technicians but are often prospective top executives and managers. Their apprenticeship is generally of about three years' duration, covering all or most departments of the firm. It is common for them to follow a sandwich course for a Higher National Diploma or a degree (or, formerly, a Diploma in Technology) and to reach professional status.

(d) Graduate Apprenticeship

This is normally a two-year course of training immediately following graduation at a university or college, prior to a post of responsibility. It often covers experience in all or most departments of the firm even when the graduate intends to specialise in a particular field. Sometimes the first year of practical training is taken between school and university and the second after graduation. Such apprenticeships lead, of course, to technologist and not technician appointments.

(e) It should be noted that titles other than the above are sometimes used, e.g., 'Engineering Apprenticeship' for 'Technician Apprenticeship'. The term 'Student Apprenticeship' may also have different meanings.

4. Although the national and local activities in the training of apprentices which are outlined in the following paragraphs may be concerned primarily with craft apprenticeship, they also apply in some measure to apprentices being trained for technician occupations.

B. INDUSTRIAL TRAINING IN THE UNITED KINGDOM UP TO 1958

1. Up to the passing of the Industrial Training Act of 1964, which is dealt with in Chapter IX, there was no statutory legislation to govern

or control industrial training in the United Kingdom. Certainly up to the last war, the training of all classes of employees was essentially a matter for individual firms and there was little co-ordination of training at industry level. Despite this, a highly skilled labour force had been built up.

2. After the war, modern trends towards increased production and greater complexity, swifter change in industrial methods, the condition of full employment and the imperative need to make the most of the country's manpower all combined to demand a greater degree of central co-ordination in labour matters, including training. The urgent problem of the 'bulge' in the numbers of school leavers in the late 1950s and early 1960s had also to be met.

The fruitful war-time co-operation in industry and the Government Report of 1945 on "The Recruitment and Training of Juveniles for Industry" prompted the setting up of training plans in industry and the formation of many Apprenticeship and Training Councils or Committees between the employers' organisations and the trade unions. One result of this has been the institution, with the assistance of the Ministry of Labour, of some 120 apprentice and other training schemes, though these have generally been couched in broad terms and have not included prescribed programmes of training. The apprenticeship schemes have invariably included provision for apprentices to be given, up to the age of 18, day-release to attend a technical college course for one day a week without loss of pay. In engineering, however, most apprentices who make satisfactory progress are granted day-release until the end of apprenticeship and, as stated previously, many employers are willing to extend release beyond this in selected cases. Many, too, now support block-release and sandwich courses for their apprentices, particularly technician apprentices, for whom adequate technical education is as important if not more important than workshop experience.

The apprenticeship schemes also usually contain provisions that the apprentice shall be moved from one branch of work to another, to widen his experience. They do not, however, require him to be given any test of competence in his trade either during or at the end of apprenticeship and such tests are not required in the United Kingdom except perhaps in the Services (Navy, Army and Air Force) where they are used for classification purposes. At the end of his apprenticeship, the apprentice becomes technically a skilled man however good or inferior his training has been.

Apprenticeship schemes also deal with matters such as length of apprenticeship, admission of late entrants etc. Most apprenticeships terminate at 21 and the duration of craft apprenticeships varies from three to five years according to the trade and other circumstances, allowance usually being made for any pre-apprenticeship training such as a full-time pre-apprenticeship course at a technical college. The tendency is for the length of apprenticeship to be reduced.

3. In some industries, action did not end with the formation of a basic industry scheme, and a number of employers' organisations and joint bodies built up advisory services on recruitment, education and training. In the Iron and Steel industry, area committees were set up and six full-time training officers were appointed by the British Iron and Steel Federation to advise member firms on the organisation of training programmes, to arrange with local education authorities for the provision of suitable courses, to collaborate with schools and the Youth Employment Service of the Ministry of Labour in bringing openings in the industry to the notice of young people etc. The Federation also produces a wide range of instructional aids and publications for training.

In engineering, the Engineering and Allied Employers' National Federation and the Confederation of Shipbuilding and Engineering Unions set up a National Joint Body and local training committees, and in some areas training organisers were appointed. The National Joint Body devised five syllabuses of training which established minimum standards of employment and training of juvenile workers in the industry, to cover a number of trades and form a general framework within which individual firms could adapt their training schemes to their own requirements.

4. Although apprenticeship training in engineering has not in the past been regulated, many firms have a long and honourable record of first-class training schemes for their apprentices. One large engineering firm opened its Works School as far back as 1914, founded its own Education Department in 1916, opened its new Apprentices Training School in 1951 and has records of training over 30,000 apprentices, some of whom now occupy leading positions in the professions of electrical and mechanical engineering. Several other firms have complete Works Schools, recognised by the City and Guilds and other bodies for craft and technician courses. Most progressive firms have Apprentice Training Depart-

ments or Centres, sometimes providing supplementary classes in association with local technical college courses. There are, however, other firms, and particularly small ones, which do not take apprentices but employ craftsmen and technicians trained by others. Many small firms which concentrate on a narrow range of products cannot offer a comprehensive training for apprentices.

C. THE INDUSTRIAL TRAINING COUNCIL

1. In 1956, the National Joint Advisory Council, which consisted of representatives of the British Employers' Confederation, the General Council of the Trades Union Congress and the Boards of Nationalised Industries, under the chairmanship of the Minister of Labour, appointed a Sub-Committee to consider the training of young workers in industry. The immediate reason for the enquiry was anxiety over the future of the greatly increased number of young people due to leave school in the late 1950s and early 1960s - the 'bulge' - and the need to ensure that they should have opportunities of training suited to their abilities, but the enquiry extended to the whole field of training. The Sub-Committee made wide and detailed enquiries into the training of young people in the United Kingdom and abroad and in 1958 published its reports, "Training for Skill: Recruitment and Training of Young Workers in Industry", often called the Carr Report from the name of the Sub-Committee Chairman, who was Parliamentary Secretary to the Minister of Labour.

2. In the Report, the Sub-Committee made many criticisms of existing apprenticeship arrangements. Facilities for apprenticeship training were inadequate in quantity and also, in some cases, in quality and some existing practices needed re-examination. Training arrangements should be flexible and should meet the circumstances of different occupations. More firms should undertake the training of apprentices and increased use should be made of arrangements such as group apprenticeship schemes, joint training centres, pre-apprenticeship courses at technical colleges, and block-release and sandwich systems of training.

There should be more flexibility in maximum age of entry to apprenticeship and appropriate standards of entry should be set, while the period and content of apprenticeship should be reviewed. While not un underrating the value of tests in training, the Sub-Committee did not advocate the institution of compulsory final tests of competence at the end of apprenticeship. Its final recommendation was the establishment of a National Apprenticeship Council, with the specific function of following up the recommendations of the Report and of collecting and disseminating information about aspects of training common to more than one industry. This Council should be formed by industry itself, co-operating with the Ministries of Labour and Education.

3. Following this recommendation, the Confederation, the Congress and the Boards of the Nationalised Industries set up the Industrial Training Council, financed by and responsible to them but assisted by a grant from Government to encourage the appointment of training officers etc. By 1960, the Council had fully developed its Training Advisory Service with its staff of Training Development Officers covering the whole of the United Kingdom. These conducted surveys in industries or individual firms to suggest levels and programmes of training, assisted on specific problems, provide consultative and information services, arranged conferences, ran courses for training officers and instructors, and promoted group training schemes.

D. GROUP APPRENTICESHIP SCHEMES

There is a large number of small firms in engineering and many of them, though very willing to give sound apprenticeship training, have difficulty in providing it because they cannot, with their limited facilities and range of products, create a sufficient variety of training situations nor maintain the necessary staff of training organisers and instructors. One solution is a group apprenticeship scheme in which firms combine together to train their apprentices, who are then interchanged between the firms to gain the necessary breadth of training. There are several forms of group apprenticeship schemes, many on a local but some on a national basis. Some were in being before the formation of the Industrial Training Council but their growth has been stimulated by it. In some cases, they are a joint operation between the technical colleges and local firms, which encourages the matching of industrial training and college courses, and also makes the college workshops available for parts of the training. Some group schemes provide central workshop facilities while others use only the workshops of member firms. A distinct advantage of the schemes is that training can be tailored to the apprentice, each apprentice having his own programme according to his need and abilities, which is of particular value for technician apprentices. Some 75 groups are known to exist under at least 25 schemes.

E. FIRST-YEAR APPRENTICESHIP TRAINING SCHEMES

1. In 1960 came two further developments, the introduction of first-year apprenticeship training schemes in Government Training Centres under the Ministry of Labour and of full-time one-year integrated courses of technical education and apprenticeship training at technical colleges, on the recommendation of the Ministry of Education (now the Department of Education and Science).

2. The Ministry of Labour instituted the Government Training Centres shortly after the 1914-18 war to train adults in various trades through intensive systematic courses of from six to twelve months'duration. Their number was greatly increased after the last war to cater for men leaving the Services and then dropped to some 20 centres, all still engaged on adult training. The Ministry also supported a number of voluntary centres which trained the physically-disabled on similar lines.

The first-year apprenticeship training scheme at Government Training Centres was introduced primarily as a demonstration to firms whose training facilities were limited of the possibilities and value of group apprenticeship schemes of systematic training, and to encourage such firms to join together and establish such schemes. It also permitted small firms to take on more apprentices during the 'bulge' years and relieved them of the onerous first year when, under a systematic programme of training, the young apprentice needs much attention. The scheme applied only to engineering trades and was at first limited to 300 places but by 1964 there were over 700 places available in mechanical and electrical trades at 24 centres.

3. A few technical colleges had for many years provided facilities for combined educational courses and industrial training in their own workshops for certain employers who, for various reasons, were themselves unable to provide satisfactory basic industrial training. In 1960, the Ministry of Education suggested to local education authorities that where sufficient workshop and other facilities were available in technical colleges, full-time one-year integrated courses of technical education and apprenticeship training should be provided in collaboration with employers. Authorities might also provide pre-apprenticeship courses of similar type for students who had left school but not yet entered employment. By 1964, over 60 local education authorities had implemented the Ministry's recommendation of one-year integrated courses and the number of students on them was of the order of 4,000.

4. Experience of these two types of courses has shown clearly that if young people on leaving school are given a systematic course in the basic principles of their trade, their progress thereafter to full skill is more rapid and their adaptability is much greater than if they had begun with ordinary production work.

The activities of the Industrial Training Council have now been overtaken by the introduction of Industry Training Boards under the new Industrial Training Act, dicussed in the next chapter.

Chapter X

TRAINING UNDER THE INDUSTRIAL TRAINING ACT, 1964

1. Ever since the last war, the United Kingdom has been short of skilled labour, even in those parts of the country where the general demand for labour has not been high. Shortage of skilled manpower has been a factor in holding back economic expansion, while technological progress has required an increasing proportion of trained and technically qualified manpower in the working population. These and other factors have demanded a thorough review of the system of industrial training.

As shown in the previous chapter, a main weakness was that the amount and quality of industrial training were generally left to the unco-ordinated decisions of a large number of individual firms. Many of these lacked facilities for adequate training and some lacked the incentive to invest in the training of people who, once trained, might leave them for other firms. On the other hand, many firms which spent large sums on training carried more than their fair share of the total cost.

2. The Government therefore decided that the time had come to strengthen and improve the existing partnership between industry, the Government and the educational authorities in the provision of industrial training, and in 1962 published its proposals in a White Paper for discussion and comment, which led to the passing of the Industrial

Training Act in 1964. The provisions of the Act have been welcomed by all parties and are now (1965) being rapidly implemented. Full implementation in all industries may take some years but sufficient has been accomplished to show the implications of the Act and the pattern for the future.

A. OBJECTIVES OF THE ACT

The three main objectives of the Act are:

(a) To ensure an adequate supply of properly trained men and women at all levels in industry;

(b) To secure an improvement in the quality and efficiency of industrial training;

(c) To share the cost of training more evenly among firms.

These objectives are to be achieved through the agency of Industrial Training Boards.

The Act provides for training and further education to be closely associated by laying a statutory duty on the Boards when making recommendations about training to make also recommendations about the further education to be associated with the training.

The Act covers all activities of industry and commerce at all levels.

B. THE INDUSTRIAL TRAINING BOARDS AND THEIR COMMITTEES

The Boards are established, and their members appointed, by the Minister of Labour who, before setting up a Board, consults both sides of the industry concerned, the Secretary of State for Education and Science and the Secretary of State for Scotland. Each Board has technical college teachers and an officer of a local education authority as members. The size of Boards is not specified under the Act and may vary according to the industry. The number of Boards, also, is not specified, but it has been estimated that some 30 will be required in total. A Board may be approved for a single industry or for a group of related industries.

With the approval of the Minister of Labour, the Boards may appoint committees or join with other Boards in appointing Joint Committees.

C. DUTIES AND POWERS OF THE INDIVIDUAL BOARDS

1. The Boards have two main duties, viz.:

   (a) To publish recommendations on the nature and length of training and the associated further education appropriate for occupations in the industry;

   (b) To ensure that adequate facilities are available for the training required.

2. The powers of a Board are wide but must have the Minister's approval. They extend to all forms of training and to all occupations within the industry concerned, and include the following powers:

   (a) To provide for the Board's administration and secretariat, and to appoint its officers and staff, including training officers and assessors;

   (b) To establish committees, e.g., national, regional and area committees, and special committees;

   (c) To impose a periodic levy on all employers in the industry to meet the cost of industrial training;

   (d) To make grants to employers whose training courses are approved by the Board, including grants for the industrial training of students attending sandwich courses;

   (e) To require employers to keep records and make returns on numbers of employees and other relevant statistics;

(f) To provide training facilities and courses, to arrange for other organisations to provide training, and to approve existing training schemes;

(g) To make recommendations about persons by whom training ought to be given;

(h) To make arrangements for applying tests of the attainment of standards and to award certificates;

(i) To assist in the training of trainees who are in the United Kingdom from overseas but are not employed or intending to be employed in the industry at the Minister's request;

(j) To engage in or assist research.

3. The Boards have no power to approve courses of further education nor to determine the content of such courses. This will remain the responsibility of the further education service. The Boards have, however, the duty of recommending which courses of further education should be associated with industrial training.

4. The Minister of Labour has power to make loans or grants to the Boards from public funds. These grants supplement the sums raised by the levy on employers and constitute a significant contribution to the work of the Boards. Their amounts and the conditions governing them are not laid down in the Act but are matters for discussion between the Minister and each Board.

5. Each Board is independent and makes its own proposals to the Minister of Labour for approval, so that, within the provisions of the Act, proposals can vary with different Boards, not only on training schemes but also on such matters as the rates of levy on employers and the grants paid to them for training provided.

D. THE LEVY AND THE GRANT

1. The Act does not itself exempt any employer within the scope of a Board from the obligation to pay a levy but a Board may, if it wishes,

propose that employers of a particular class should be exempted. For example, a Board could exclude very small firms, provided the Minister approved.

Each Board determines the rate of levy for its own industry, the rate being fixed in the light of the Board's general policy and plans, subject to the Minsiter's approval. Together with the grant from the Ministry (see para. C.4) it has to be sufficient to meet the cost of the proposals which the Board puts foward. The total levy and the Ministry grant together must cover: the administrative expenses of the Board, any training undertaken directly by it or provided by an outside organisation on its behalf, any research carried out by the Board, and the grants made by the Board to employers for the training they provide.

2. An employer who provides no training has to pay the levy but receives no grant for training from the Board; thus, in effect, he is paying through the levy for the training of the skilled manpower he recruits. An employer who provides approved training pays the levy similarly but receives grant towards the cost of training which will offset all or part of his levy. If he does more than his fair share of training he may receive more in grant than the levy he pays.

The Act has provisions for appeal against assessment of levy but not against the rate of levy.

The Act imposes no obligation on an employer to provide training himself but since all employers will pay levy they will have an incentive to see that their employees receive training, and of a standard approved by the Board.

3. The rate of levy in an industry will clearly depend to some extent on the amount and character of industrial training required in relation to the total roll of employees. An industry which has a large proportion of skilled craftsmen, technicians and other highly qualified personnel will clearly spend more per capita on training than one which has a large proportion of operatives (i.e., men who operate machines or processes and are often semi-skilled but not classified as craftsmen) and unskilled labour.

E. THE PROVISION OF INDUSTRIAL TRAINING

1. The levy and the grants paid by the Board to individual firms will be related primarily to the cost of industrial training, which may be provided in any of the following:

(a) In industry itself, either in training centres or otherwise;

(b) In a Government Training Centre;

(c) In a technical college or other college of further education;

(d) In a centre specially established by the Board.

It is for the individual firm to decide the way its industrial training shall be provided but if a firm wishes to be eligible for grant its arrangements must meet the standards recommended by the Board. Thus, however the training is provided, its standard will need to satisfy the Board if grant is to be paid.

2. The Boards are not merely concerned with apprentice training but with training at all levels. Adult training and re-training are important activities and in these fields especially the Government Training Centres have been and are of the greatest value. The Government has already taken steps to increase the number of Government Training Centres and the numbers of places in existing ones. Six new Centres have been established, bringing the total to 30, and two more are planned. By the end of 1965, the Centres had 6,000 places, were able to produce up to 12,000 trained men a year, and the resulting provision for industrial training and re-training have more than trebled in a little over two years.

F. THE TRAINING OF TRAINING OFFICERS AND INSTRUCTORS

The implementation of the Act is increasing the demand for training officers and instructors, and there is a corresponding need of training courses for these. Representatives of a selection of technical colleges in different parts of the country have met the Ministry of Labour and the Department of Education and Science and discussed the provision of short full-time basic courses, for training officers, and a number of these courses, approved by the Ministry and the Department, are already in being at colleges.

The expenses of training officers sent by firms on such approved courses are to be met wholly or in part by the Boards, with the assistance of the Ministry grant. To firms in industries for which Boards have not yet been established, the Ministry is paying a grant of half the tuition fee.

As a service to industry, the Ministry of Labour has for many years provided two-week basic courses for craft instructors at two of its principal Government Training Centres, one in England and the other in Scotland, and these Centres continue to be available.

G. THE CENTRAL TRAINING COUNCIL

The Act provides for the appointment of a Central Training Council to advise the Minister on the administration of the Act and on industrial training generally. The Council has no executive responsibilities but advises the Minister on a wide range of questions, such as the adequacy of training arrangements in industry generally or in particular industries, the establishment of Training Boards, training methods, the use of tests etc., research, and other matters which arise.

The Council was appointed immediately the Act was passed and under its independent Chairman has six members from the employers, six from the Trade Unions, two from the Nationalised Industries, three who are Chairmen of Industrial Training Boards, six from education authorities, associations and technical colleges, and six independent members closely associated with industrial training and technical education. Officers of the Ministry of Labour, the Department of Education and Science and the Scottish Education Department attend meetings of the Council.

The Council has already appointed a number of special Committees, viz.:

General Policy Committee
Commercial and Clerical Committee
Research Committee
Scottish Committee
Welsh Committee

and others are under consideration.

H. INDUSTRIAL TRAINING BOARDS ESTABLISHED UP TO DECEMBER, 1965

The following Boards had already been established by August, 1965:

(i) Engineering Industry Training Board;

(ii) Construction Industry Training Board (Civil Engineering, Building etc.);

(iii) Iron and Steel Industry Training Board (Manufacture of iron and steel);

(iv) Wool Industry Training Board (Wool Textiles);

(v) Shipbuilding Industry Training Board;

(vi) Electricity Supply Industry Training Board (A nationalised industry);

(vii) Gas Industry Training Board (A nationalised industry supplying gas for power and domestic uses);

(viii) Water Supply Industry Training Board;

(ix) Ceramic, Glass and Mineral Products Industry Training Board;

(x) Furniture and Timber.

The composition of the boards, apart from the chairman, and in certain cases (construction, wool, ceramics) the deputy chairman, is as follows.

Industry Training Board	Members		
	Employers	Trade Unions	Education
Engineering	9	9	5
Construction	10	10	6
Iron and Steel	5	5	3
Wool	6	6	4
Shipbuilding	6	6	4
Electricity	6	6	4
Gas	7	7	4
Water	5	5	3
Ceramics, Glass, Mineral	8	8	4
Furniture and Timber	7	7	4

I. BOARDS YET TO BE ESTABLISHED

1. Boards are expected to be established in the near future for the following industries:

Textiles other than Wool (three Boards)
Road Transport
Motor Vehicle Repair
Hotels and Catering
Retail Distribution
Agriculture
Chemicals
Plastics
Oil
Rubber
Clothing and Footwear

2. Other major manufacturing industries to be considered include:

Food
Drink
Tobacco
Paper and Board

Non-manufacturing industries to be considered include:

- Transport other than Road Transport (Shipping, Civil Aviation and Port Transport)
- Printing
- Fishing
- Insurance
- Banking and Finance

It is one of the functions of the Central Training Council to advise the Minister of Labour on the priority to be given to the establishment of Boards.

J. ACTIONS OF THE ESTABLISHED BOARDS

1. The Engineering I.T.B.

The Board has compiled a register of firms in the industry which has been limited, for the time being, to firms with five or more employees. The register contains about 27,000 firms with some 3,700,000 employees.

The Board has established Committees for Training, Finance, Staffing and the Levy; the Training Committee has set up seven Sub-Committees for different categories of employee and one for the integration of education and training.

The Engineering I.T.B. and the Iron and Steel I.T.B. are both concerned with the foundry industry and have therefore set up a Joint Committee for Training in the Foundry Industry.

2. The Construction I.T.B.

The Board has compiled a register of firms within the industry which has been limited at present to firms of five or more employees. The register contains some 37,600 employers with 1,500,000 employees. It is estimated that to include all firms at this stage would more than double the number on the register.

A Chairman's Advisory Committee has been appointed and Industrial Advisory Committees have been set up for Building, Mechanical Engineering Services, Electrical Engineering Services and Civil Engineering. Sub-Committees of the Building Committee have been set up for operative training, technician and technologist training, and management training.

3. The Iron and Steel I.T.B.

The board is compiling a register which contains about 580 establishments with some 319,000 employees. Working Parties have been appointed to consider the training requirements of craft apprentices and operatives and to recommend interim standards for payment of grant to employers in the first year. Working Parties have also been set up on Statistics (Information and Records), Training Costs, and Training for Iron Ore Mines and Quarries.

4. The Wool I.T.B.

The Board has established a register of nearly 2,000 firms covering about 170,000 employees, and set up Area Committees for West Riding of Yorkshire and the Midlands, the West of England, and Scotland. It has also appointed Advisory Committees for Operative Training, Craft and Technician Apprentice Training, Advanced Training, Training Research and Careers Advice, Selection and Placement.

The Board has organised courses for Instructors at two centres and some other centres are planned for this year.

5. The Shipbuilding I.T.B.

The Board is compiling a register of establishments and has set up Committees for Training, Staffing, and Finance.

K. TRAINING LEVY AND GRANT PROPOSALS APPROVED

1. The Minister of Labour has approved the training levy and grant proposals submitted by the first five Boards, viz., the Engineering, Construction, Iron and Steel, Wool and Shipbuilding I.T.B.s, but these proposals cover only the first year of operation of the training scheme and are to be regarded as transitional, likely to be modified and improved for later years as training develops and is extended through the industries. To begin with, a Board may concentrate on proposals concerned mainly with craft and technician apprentices, and later extend them to all classes of employee up to and including managerial staff.

Each Board has to determine the size of the industry, the number and types of firms, the numbers of employees in various classes etc., and to prepare estimates of the future manpower requirements of the industry. It can then decide the training programme required for the full needs of the industry, though this will not remain static but require constant review.

A brief outline of the training levy and grant proposals approved for the first five Boards is given below, but this does not state the actual grants to be made since these may well be altered in future proposals.

2. The Engineering I.T.B.

(a) Levy

For the year 1966, the Board is imposing a levy at the rate of 2 1/2% on the salaries and wages paid by each registered firm during the year ended 5th. April, 1965, but firms with a total salary and wages bill of less than £ 5,000 during the period are this year not subject to levy. It is estimated that the levy will yield a total sum of about £ 75,000, 000.

(b) Training Grants

Grants payable for training during 1966 will consist of two parts.
Part A: The General grant for all employees under training;

Part B: Supplementary grants for aspects of training which the Board wishes to encourage.

Part A: General grant will cover all categories of employees receiving training whether at apprentice/learner or adult stage, viz.

Operatives
Craftsmen
Technicians
Supervisory staff
Administrative, commercial and clerical staff
Scientists and technologists
Managers and Superintendents.

Part B: Supplementary grants will be paid for:

(i) Employees taking sandwich courses for a Diploma in Technology (or a degree) or a Higher National Diploma;

(ii) Approved courses taken by Training Officers and by Safety Officers.

3. The Construction I.T.B.

(a) Levy

For 1965-66, the Board is imposing a levy at the rate of 0.5% on the salaries and wages paid by each registered firm during the year ended 5th. April, 1965. Firms with a total salaries and wages bill of less than £ 5,000 during the period are this year excluded from the levy. It is estimated that the total yield will be some £ 6,000,000.

(b) Training and Re-Training Grants

The Board emphasises that the scheme of grants is transitional and designed for the earliest start in raising training standards and increasing the amount of training carried out. The main features of the scheme are:

(i) Fixed-scale grants in respect of indentured or registered apprentices, student and technician apprentices, articled clerks etc. /see Chapter IX para. A.2 (b) and A.2 (c7

(ii) Variable grants for employees taking certain courses of education and training, and for some other training features;

(iii) Supplementary grants based on (i) and (ii) above or on audited expenditure related to training.

The grants for students taking sandwich courses for a Diploma in Technology (or a degree) or a Higher National Diploma will be greater than for those taking other courses. Grant will be paid for attendance of Training Officers at approved courses.

4. The Iron and Steel I.T.B.

(a) Levy

For 1965-66, the Board is imposing a levy of £ 7 per employee on firms in the industry and no firm is to be exempted from the levy. This should yield a total of some £ 2,200,000.

(b) Training and Re-Training Grants

For the first year, the Board is concentrating its attention mainly on operative and craft apprentice training, and is preparing further recommendations and standards for other categories of employee, including technicians, technologists, commercial and clerical staff, foreman and managers etc., which will be related to the grant system.

Grant is to be paid to firms providing training for craft apprentices and operatives which complies with the standards to be laid down. Higher grants will be paid for students taking sandwich courses for a Diploma in Technology (or a degree) or a Higher National Diploma. Grant will also be paid for attendance of Training Officers at approved courses.

The Board will also pay grant to support approved research projects associated with training in the industry.

The Wool I.T.B.

(a) Levy

For 1965-66, the Board has imposed a levy at the rate of 0.75% of the total gross salaries and wages paid by each registered establishment during the year ended 5th. April, 1965, and it is estimated that this will yield £ 800,000.

(b) Training and Re-Training Grants

The Board proposes to make recommendations about training standards for all employments within the industry and to make arrangements to assist employers to meet those standards. In the meantime, grant is being paid in respect of such training as is at present undertaken by employers. Grant may be claimed under two heads:

(i) Fixed-scale grants in respect of training and re-training of operatives, and of the training of craft, technician and technologist apprentices.

(ii) Grants in respect of certain approved items of expenditure relating to training, such as attendance of employees at courses of management and supervisory training, commercial courses, and approved courses for Training Officers.

A higher grant is payable for employees taking sandwich courses for a Diploma in Technology (or a degree) or a Higher National Diploma.

For the training and re-training of operatives, a fixed 'training value' has been established for each category of operative as a basis of grant payable.

6. The Shipbuilding I.T.B.

(a) Levy

For 1965-66, the Board is imposing a levy at the rate of 0.55% of the total taxable payroll of each registered establishment during the year ended 5th. April, 1965.

(b) Training Grants

Pending the review of training throughout the industry, the Board proposes to pay grant for 'off-the-job' training, separate from the production line within the establishment or at Government Training Centres, technical colleges and other approved centres, and for associated courses of further education by sandwich, block-release and part-time day attendance (but not for evening-only courses). Grants will also be paid for attendance by Managers, Supervisors, Safety Officers, Training Officers and Instructors at approved courses of training. A higher grant is payable for employees taking sandwich courses for a Diploma in Technology (or a degree) or a Higher National Diploma.

The addresses of the Department of Education and Science, the Scottish Education Department, the Northern Ireland Ministry of Education, the City and Guilds of London Institute, the Ministry of Labour, the Central Training Council and the Engineering, Construction, Iron and Steel, Wool and Shipbuilding Industry Training Boards are given in Appendix 10.

L. THE EFFECTS OF THE INDUSTRIAL TRAINING ACT

It is clear that the Act will have a great and far-reaching effect on industry and education in the United Kingdom, and will affect virtually all firms throughout industry and commerce. Industrial training, instead of being unco-ordinated and often haphazard, a matter largely for the individual firm, becomes the responsibility of a whole industry. No employer has to train but if he fails to do so he pays for others to provide the training from which he benefits. Those who train will be reimbursed for the training they provide, whether for themselves or others.

Within the general provisions of the Act, the individual Boards are in a large measure autonomous, free to determine and provide the training needed in their own industry. As they evolve their schemes of training, linked with appropriate courses of further education, they will spur employers to require that their own employees are suitably and effectively trained. The supply of the skilled manpower so much needed will increase and manpower requirements will be under constant review. Yet there is no rigid national control of either training or education, but a freedom to develop both according to circumstances and needs, which is, after all, the British tradition.

Chapter XI

THE FUNCTIONS OF TECHNICIANS IN INDUSTRY

A. INTRODUCTION

It is clearly important that the education and training of technicians should be planned with due regard to the function which they perform. Because the importance of the role of the technician, and the need to provide courses especially designed for his needs, have only fairly recently been recognised in the United Kingdom, it cannot be claimed that there exists, as yet, a sufficiently wide choice of courses to meet completely the needs of all engineering technicians, but the situation in this field is improving rapidly. It was, however, considered desirable to take a sample of the jobs done by technicians in industry, and to examine the extent to which the education and training which the technicians had received could be said to have fulfilled their needs.

The immense variety of work done by technicians in the engineering industry makes an investigation of this kind very difficult; but it is this very variety which justifies such an enquiry. It would hardly prove possible, even if it were desirable, to provide different schemes of education and training for every type of engineering technician. It is important to decide whether the courses for technicians of similar but not identical types can have a common element. Since there exist at the moment relatively few technician courses, it is an appropriate time to examine the extent to which they are adequate to provide a background for the numerous technician types which existed even in the small sample considered.

1. The O.E.C.D. Enquiry into the Function of Technicians

The O.E.C.D. decided to make a sample investigation of the actual jobs done by technicians in certain member countries, including Great Britain. This sample was taken in three fields, namely:

(a) The Electronic Measuring Instrument Industry

(b) The Machine Industry

(c) The Electricity Generation, Transmission and Distribution Industry

Thus the sample included a modern electrical industry (Electronic Instruments), a long established mechanical industry (Machine Tools), and a nationalised, public-service industry. In each of the first and second cases, three firms were taken, of different sizes and types, as representative samples of the industries. In the third case, investigations were made in four areas, two concerned with electricity generation and two with distribution and supply. The size of the organisation sampled is indicated in the following table:

	Electronic Measuring Instrument Manufacture	Machine Tool Manufacture	Electricity Generation Transmission Distribution
Total persons employed (approx.)	2,100	2,800	1,900
1. Qualified Scientists and Engineers	85	70	44
2. Technicians	388	383	155
3. Craftsman and equivalent . . .	299	944	1,533
Ratio of 1. to 2.	1:4.6	1:5.5	1:3.5

As the sample was a small one, and even within it, there existed a wide variety between the figures for different firms in a similar industry, it would be unwise to draw any general conclusions from the above figures, which are included solely to give some indication of the size of the sample taken. Certain common factors appeared in the three investigations. The first was a general lack of definition in the function performed. In very few cases did a job actually bear the name of "technician"; and in order to identify the right people for investigation it was often necessary first to reach agreement with the employers or supervisors as to which functions could properly be regarded as technician ones, and which people were performing them. There was often no clear-cut line of demarcation between professional engineer and higher technician jobs; and an equal lack of definition was evident at the junior technician/advanced craftsman boundary.

2. Accepting within the investigation certain occupations which might be regarded as marginal, the number of technician roles indentified was 31 in the electronic measuring instrument firms visited, 20 in the machine tool enterprises and 27 in the electrical generation and supply industry. The following list shows the titles used by the firms (it will be noticed that to designate a "technician" the term "engineer" is commonly used).

Electronic Measuring Instrument Manufacture	Machine Tool Manufacture	Generation, Transmission and Distribution of Electricity
Research and Development:	Technical Representatives	Mains Engineering:
Assistant Development Engineers	Sales Engineers	Assistant Distribution Engineers
Mechanical Designers	Technical Estimators	General Assistant Engineers
Senior Prototype Wiremen	Project Engineers	Sub-Station Control Engineers
Draughtsmen	Draughtsmen	Senior Engineering Draughtsmen
Technical Writers	Service Engineers	Second Assistant Engineers
Standardising Writers	Service Representatives	District Engineers
Production Engineering:	Production Planners	First Assistant District Engineers
Production Engineers	Time Study Men	Assistant Engineers
Tool Design-Draughtsmen	Production Controllers	Assistant District Engineers
Planning Engineers	Methods Engineers	Technical Staff Trainees
Coding Officers	Finished Machine Tool Testers	Commercial Engineering:
Methods Engineers	Run-off and Test men	Commercial Engineers (Consumer)
Test Methods Engineers	Demonstrator/Testers	Assistant Commercial Engineers
Test Equipment Designers	Development Engineers	Second Assistant Engineers (Commercial)
Test Equipment Engineers	Prototype Builders and Testers	District Commercial Engineers
Work Study Engineers	Research/Development Dept. Technician Staff	
Time Study Engineers		

Electronic Measuring Instrument Manufacture	Machine Tool Manufacture	Generation, Transmission and Distribution of Electricity
Evaluation Engineers	Quality Control Engineers	Assistant Engineers Commercial
Production Testing:	Chief Inspectors	Assistant District Commercial Engineers
Senior Test Engineers	Inspectors	Generating Stations:
Test Engineers		Assistant Mechanical Maintenance Engineers
Quality Control:		Assistant Electrical Maintenance Engineers
Standards Engineers		Assistant Station Chemist
Mechanical Inspectors		Method Study Engineer
Electrical Inspectors		Planning Engineer
Electrical Inspectors (Final Test)		Shift Charge Engineers
Quality Control Advisers		Assistant Charge Engineers
Quality Control Engineers		Control Engineers
Environmental Test Engineer		Assistant Efficiency Engineer
Service:		Assistant Engineer (coal and ash)
Service Engineers		
Commercial:		
Applications Engineers		
Sales Training Officers		
Market Research Officers		
Technical Sales Representatives.		

This list is not as surprising as it looks, when viewed from the point of view of education and training. For many of the different titles arise from specific slants given to jobs which have a great deal of basic similarity. Many of them can be prepared for by relatively few educational courses planned for mechanical, or electrical, or electronic technicians, as the case may be, the different slants being achieved by training within the enterprise. There is no doubt that the Industrial Training Act will make a massive contribution to achieving a solution in something like these terms. The Engineering Training Board has already indicated a method of procedure, for it has planned a basic course of "off-the-job" training which will be common to almost all engineering craftsmen and technicians. Whilst the education which accompanies this nine-months basic course will need to include, of course, whatever theory is necessary to provide an adequate background, the way in which this theory is presented, the mathematical treatment accorded to it, and the extent to which it is augmented by other relevant material will be determined by whether the educational course being followed is for craftsmen or technicians; and, in the latter case, it will vary between mechanical, electrical or electronic technicians. The basic training course will be followed by courses of a more specialised nature, and these have yet to be devised. It is expected that, as far as technicians are concerned, the existing educational courses will generally prove suitable, although some modifications will have to be made. It is likely that further courses for technicians will be devised, as well as additional options in the later years of technicians courses, designed to give particular specialist biases, as needed, on the lines of the present Mechanical Engineering Technicians course.

3. As mentioned earlier the investigation included a consideration of the extent to which the educational courses which technicians had followed had proved adequate to their needs. This enquiry did not prove very fruitful, because many of the upper level technicians had received their early training well before the present range of technician courses existed.

There were found to be three ways by which technicians had reached their present positions. The first type was the man who had grown with the job. This man often holds no formal qualifications, and has acquired his techniques by a step-by-step extension of his experience, and his background knowledge by independent study. He is often an extremely valuable type of technician which will obviously continue to exist. However, there is little doubt that many such men are unqualified because of the lack of suitable courses in their early days; and some missed opportunities for formal training because of the 1939-45 War. It is significant that nearly all the formally unqualified technicians interviewed were over 40 years old, and a very high percentage were over 55. Thus the further development of well-planned schemes of education and training properly related to technician functions should in future years make technicians of this type rare.

The second type was the promoted craftsman; or, indeed, he may have begun at a lower level, such as operative or semi-skilled worker. There are many examples of workers whose record at school was average, but who have shown latent talents which have developed rapidly under the incentive of employment. It is important that ways should continue to exist whereby such workers can attain their full potential. There are some technician occupations (e.g. electrical installations technician, motor vehicle technicians etc.) where an initial training as a craftsmen constitutes a normal precursor to technician work. No doubt the training courses now being devised by the Training Boards will pay due regard to the need for providing adequate transfer arrangements to technician training where this is desirable; and the present reasonably flexible educational arrangements will be, generally, retained.

The third type, growing rapidly in numbers, points the way to the future, for it includes a large proportion of the younger technicians. These have left school at 15, but commonly 16, with a sound background knowledge of mathematics and elementary science. They are capable of being educated and trained for direct employment as technicians over a period of two, three or four years, dependent upon the particular techniques involved, to a standard where they can undertake work involving technical appreciation, analysis and judgement in a particular field. They also have ability to keep abreast of developing or changing techniques through the study of technical literature.

B. TECHNICIAN LEVELS

It is upon this third type of man that the effectiveness of the technician force of the future will mainly depend. The discussions which constituted such an important part of the "functions" survey indicated that there are already, and are likely to be in the future, two broad levels of technicians. The upper level technician may attain a standard only a little below that of a professional engineer. Indeed such a man may fill a post superior to that occupied by a young graduate engineer who may, in his early stages, be given work of a technician character, to provide him with certain background experience. An upper level technician of this type may well possess a Higher National Certificate, or perhaps, in the future, the Advanced Technicians Certificate of the City and Guilds of London Institute.

Technicians of a lower level may well possess an Ordinary National Certificate, or perhaps a City and Guilds Technicians Certificate. At present, it seems less usual for the O.N.C. to be a terminal qualification for a technician than a City and Guilds Certificate. There are, and will continue to be, many technicians at this junior level who are young men who will subsequently achieve promotion to the higher level. For the reasons mentioned earlier there was no very close degree of correlation between academic attainment and the level of technician function being investigated. Whilst there was a general consensus of opinion among employers and supervisors that the higher level posts needed technical background at about the level of the Higher National Certificate, it was equally firmly agreed that the possession of such knowledge was not as such a sufficient requirement. Examples were found of technicians with H.N.C, and one or two of University graduates - who were fulfilling a relatively junior technician function, because they lacked the necessary practical ability for the job. There is little room in industry for the "theoretical technician".

C. TECHNICIAN TRAINING

There is of course much closer correlation between the training given and the actual technician function. Much of the training is "tailor made" for the particular job, and in many cases is devised and operated by the individual firm. Perhaps a better indication of possible future trends is provided by the Electricity Industry investigation, which is a massive organisation with a highly organised education and training set-up. In the post-war years it has reassessed its training policy. In particular, the old view that the engineer and the technician should be as good in the use of the tools of the trade as the craftsman has given way to the view that the training should concentrate on an understanding of the potential, and of the limitations, of specific workshop processes; that the technician should thus have a good acquaintance with these processes, but that he should rely upon the skills of the craftsman for carrying them out. Hence all potential technicians receive an initial "skill training" period, in "off-the-job" workshops, in which they acquire this acquaintance with manual skills at first hand. Subsequent training is in accordance with a programme carefully planned, both as to timing and content, to cover the necessary area of work concerned with the particular technician function. It is also planned, as far as possible, to fit in with the technical education course, which may take place concurrently, or, in block-release form, precede the relevant training. It will be seen that this has much in common with the views of the Engineering Training Board mentioned earlier. There is little doubt that, when the provisions of the Industrial Training Act become more fully implemented, there will be much closer correlation between technician functions and the education and training schemes which prepare students to carry them out.

Appendix 1

EXAMINING BOARDS FOR THE GENERAL CERTIFICATE OF EDUCATION

The General Certificate of Education is awarded on the results of examinations conducted by the following nine independent Examining Boards in England and Wales.

1. Associated Examining Board for the General Certificate of Education,
   Hesketh House, Portman Square, London, W.1.

2. Durham University Matriculation and School Examination Board,
   8, Sydenham Terrace, Newcastle-upon-Tyne, 2.

3. Northern Universities' Joint Matriculation Board,
   Manchester 15.

4. Oxford Delegacy of Local Examinations,
   12, Merton Street, Oxford.

5. Oxford and Cambridge Schools Examination Board,
   Elsfield Way, Oxford, and 10, Trumpington Street, Cambridge.

6. Southern Universities' Joint Board for School Examinations,
   22, Berkeley Square, Bristol, 8.

7. University of Cambridge Local Examinations Syndicate,
   Syndicate Buildings, Cambridge.

8. University of London School Examinations Council,
   Senate House, London W.C.1.

9. Welsh Joint Education Committee,
   30, Cathedral Road, Cardiff.

The Examining Board for the General Certificate of Education in Northern Ireland is:

Northern Ireland Senior Certificate Examination Committee,
Dundonald House, Upper Newtownards Road, Belfast, 4.

SCOTTISH CERTIFICATE OF EDUCATION

The Examining Board for the Scottish Certificate of Education is:

Scottish Certificate of Education Examinations Board,
Broomhouse Drive, Saughton, Edinburgh, 11.

Appendix 2

REGIONAL COLLEGES IN ENGLAND AND WALES (25)

In Greater London

Borough Polytechnic,
Borough Road, London, S.E.1.

Brixton School of Buildings,
Ferndale Road, London, S.W.4.

Kingston College of Technology
Kingston Hall Road, Kingston-upon-Thames.

Northern Polytechnic,
Holloway Road, London, N.7.

Sir John Cass College,
Jewry Street, London E.C.3.

Barking College of Technology,
Longbridge Road, Dagenham.

The Polytechnic,
Regent Street, London W.1.

West Ham College of Technology,
Romford Road, London, E.15.

Woolwich Polytechnic,
Wellington Street, London, S.E.18.

Outside Greater London

Brighton College of Technology,
Moulescoomb, Brighton 7.

Lanchester College of Technology,
Priory Street, Coventry.

Glamorgan College of Technology,
Treforest, Glamorganshire.

Hatfield College of Technology,
Hatfield, Hertfordshire.

Huddersfield College of Technology,
Queensgate, Huddersfield, Yorkshire.

Leeds College of Technology,
Calverley Street, Leeds, 1.

Leicester College of Technology and Commerce,
The Newarke, Leicester.

City of Liverpool College of Building,
Clarence Street, Liverpool, 3.

City of Liverpool College of Technology,
Byrom Street, Liverpool, 4.

North Staffordshire College of Technology,
College Road, Stoke-on-Trent.

Nottingham and District Technical College,
Burton Street, Nottingham.

Plymouth College of Technology,
Tavistock Road, Plymouth.

Portsmouth College of Technology,
Park Road, Portsmouth.

Rugby College of Engineering Technology,
Eastlands, Rugby.

Rutherford College of Technology,
Newcastle-upon-Tyne, 1.

Sunderland Technical College,
Green Terrace, Sunderland.

Appendix 3

COLLEGES OF ADVANCED TECHNOLOGY IN ENGLAND AND WALES (10)

Note: These Colleges of Advanced Technology are all Universities-Designate and will change their titles on assuming university status.

Battersea College of Technology,
Battersea Park Road, London, S.W.11.

Birmingham College of Advanced Technology,
Gosta Green, Birmingham, 4.

Bradford Institute of Technology,
Great Horton Road, Bradford, 7, Yorkshire.

Bristol College of Science and Technology,
Ashley Down, Bristol, 7.

Brunel College of Technology,
Woodlands Avenue, Acton, London, W.3.

Chelsea College of Science and Technology,
Manresa Road, London, S.W.3.

Loughborough College of Technology,
Loughborough, Leicestershire.

Northampton College of Advanced Technology,
St. John Street, London, E.C.1.

Royal College of Advanced Technology,
Peel Park, Salford, 5, Lancashire.

Welsh College of Advanced Technology,
Cathays Park, Cardiff.

Appendix 4

NATIONAL COLLEGES IN ENGLAND AND WALES (6)

Note: These six colleges are specialist colleges with national responsibility in their individual fields of activity.

National College of Agricultural Engineering,
Silsoe, Bedfordshire.

National College of Food Technology,
St. George's Avenue, Weybridge, Surrey.

National Foundry College,
Stafford Street, Wolverhampton, Staffordshire.

National College for Heating, Ventilating, Refrigeration and Fan Engineering,
Borough Polytechnic,
Borough Road, London, S.E.1.

National Leathersellers College,
Towerbridge Road, Bermondsey, London, S.E.1.

National College of Rubber Technology,
Northern Polytechnic,
Holloway Road, London, N.7.

Appendix 5

THE 13 PROFESSIONAL ENGINEERING INSTITUTIONS IN MEMBERSHIP OF THE COUNCIL OF ENGINEERING INSTITUTIONS

The Royal Aeronautical Society,
4, Hamilton Place, London, W.1.

The Institution of Chemical Engineers,
16, Belgrave Square, London, S.W.1.

The Institution of Civil Engineers,
Great George Street, London, S.W.1.

The Institution of Electrical Engineers,
Savoy Place, London, W.C.2.

The Institution of Electronic and Radio Engineers,
8-9, Bedford Square, London, W.C.1.

The Institution of Gas Engineers,
17, Grosvenor Crescent, London, S.W.1.

The Institution of Marine Engineers,
76, Mark Lane, London, E.C.3.

The Institution of Mechanical Engineers,
1, Birdcage Walk, London, S.W.1.

The Institution of Mining Engineers,
3, Grosvenor Crescent, London, S.W.1.

The Institution of Mining and Metallurgy,
44, Portland Place, London, W.1.

The Institution of Municipal Engineers,
25, Eccleston Square, London, S.W.1.

The Institution of Production Engineers,
10, Chesterfield Street, London, W.1.

The Institution of Structural Engineers,
11, Upper Belgrave Street, London, S.W.1.

A list of Joint Committees for National Certificate and Diploma schemes in various branches of Engineering, together with the official numbers of the Rules governing each type of scheme, are given in Appendix 7.

Appendix 6

REGIONAL EXAMINING UNIONS IN THE UNITED KINGDOM

England and Wales

The Union of Lancashire and Cheshire Institutes,
Africa House,
54, Whitworth Street, Manchester, 1.

East Midland Educational Union,
1, Clinton Terrace, Derby Road, Nottingham.

Northern Counties Technical Examinations Council,
5, Grosvenor Road, Newcastle-upon-Tyne, 2.

The Union of Educational Institutions,
Norfolk House,
Smallbrook, Ringway, Birmingham, 5.

Yorkshire Council for Further Education,
Bowling Green Terrace, Jack Lane, Leeds, 11.

Welsh Joint Education Committee,
30, Cathedral Road, Cardiff.

Scotland

The Scottish Association for National Certificates and Diplomas,
38, Queen Street, Glasgow, C.1.

Northern Ireland

For the purposes of the Ordinary National Certificate course in Engineering, the Ministry of Education for Northern Ireland acts as the Examining Body for all colleges in Northern Ireland.

THE CITY AND GUILDS OF LONDON INSTITUTE

The City and Guilds of London Institute,
76, Portland Place, London, W.1.

Appendix 7

JOINT COMMITTEES FOR NATIONAL CERTIFICATE AND DIPLOMA SCHEMES IN VARIOUS BRANCHES OF ENGINEERING IN THE UNITED KINGDOM

(For England and Wales except where stated otherwise)

	Rules No.
1. Joint Committee for Ordinary National Certificates and Diplomas in Engineering	126 and 126D
Ditto (Northern Ireland)	N.I.1D
* Joint Committee for Higher National Certificates and Diplomas in Mechanical Engineering	106 (under revision)
Joint Committee for National Certificates and Diplomas in Mechanical Engineering (Scotland)	1
+ Ditto (Northern Ireland)	
* Joint Committee for Higher National Certificates and Diplomas in Aeronautical Engineering	106Ae (under revision)
+ Ditto (Northern Ireland)	
* Joint Committee for Higher National Certificates and Diplomas in Production Engineering	106P (under revision)
Ditto (Scotland)	1
+ Ditto (Northern Ireland)	

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* These three Joint Committees have recently combined to form a tripartite Joint Committee for Higher National Certificates and Diplomas in Mechanical, Production and Aeronautical Engineering for England and Wales.

+ Ditto for Northern Ireland.

Secretariat:

The Joint Secretary,
National Certificates and Diplomas Secretariat,
The Institution of Mechanical Engineers,
1, Birdcage Walk, London, S.W.1.

Rules No.

2. Joint Committee for Higher National Certificates and Diplomas in Electrical and Electronic Engineering . . 127

Joint Committee for Ordinary National Certificates and Diplomas in Electrical Engineering (Scotland) . . 1

Joint Committee for Higher National Certificates and Diplomas in Electrical and Electronic Engineering (Scotland) 1

Joint Committee for Higher National Certificates and Diplomas in Electrical and Electronic Engineering (Northern Ireland) N.I.2

Secretariat:

The Secretary,
The Institution of Electrical Engineers,
Savoy Place, London, W.C.2.

3. Joint Committee for Higher National Certificates in Civil Engineering (including Northern Ireland) . . . 107

Ditto (Scotland) 1

Secretariat:

The Secretary,
The Institution of Civil Engineers,
Great George Street, London, S.W.1.

Rules No.

4. Joint Committe for Higher National Certificates in Chemical Engineering 122

Ditto (Scotland) 1

Secretariat:

The Secretary,
The Institution of Chemical Engineers,
16, Belgrave Square, London, S.W.1.

5. Joint Committee for Higher National Certificates and Diplomas in Foundry Technology (including Scotland) . 108

Secretariat:

The Secretary,
The Institute of British Foundrymen,
135-137, Easton Road, London, N.W.1.

6. Joint Committee for National Certificates and Diplomas in Metallurgy 111

Ditto (Scotland) 1

Secretariat:

The Joint Secretary,
The Joint Committee for Higher National Certificates and Diplomas in Metallurgy,
Department of Education and Science,
Curzon St., London, W.1.

Note: Copies of the Rules, as numbered above, can be obtained from:
Her Majesty's Stationary Office,
York House,
Kingsway, London, W.C.2
and other branches of the Office in the United Kingdom.

Appendix 8

NUMBERS OF CANDIDATES FOR NATIONAL CERTIFICATE AND DIPLOMA FINAL EXAMINATIONS, 1963 AND 1964

1. ENGLAND AND WALES

	1963	1964
Ordinary National Certificates:		
Mechanical Engineering	19,017	19,511
Electrical Engineering	9,523	10,741
Metallurgy	761	679
Ordinary National Diplomas:		
Engineering	318	423
Mechanical Engineering(*)	491	578
Electrical Engineering	31	23
Higher National Certificates:		
Mechanical Engineering	6,241	6,628
Electrical Engineering	4,461	4,476
Production Engineering	761	825
Aeronautical Engineering	33	33
Civil Engineering	811	936
Chemical Engineering	100	118
Metallurgy	379	420
Higher National Diplomas:		
Mechanical Engineering	675	748
Electrical Engineering	278	436
Production Engineering	34	38
Aeronautical Engineering	13	4
Metallurgy	33	71

(*) The replacement of O.N.D. courses in Mechanical Engineering by O.N.D. courses in Engineering had not taken full effect at final stage in 1963 and 1964.

2. SCOTLAND

	1963	1964
Ordinary National Certificates:		
Mechanical Engineering	1,906	1,886
Electrical Engineering	744	783
Metallurgy	119	100
Ordinary National Diplomas:		
Mechanical Engineering	48	66
Higher National Certificates:		
Mechanical Engineering	601	628
Electrical Engineering	284	383
Production Engineering	92	94
Civil Engineering	200	192
Chemical Engineering	18	16
Metallurgy	48	48
Higher National Diplomas:		
Mechanical Engineering	11	11
Electrical Engineering	8	4
Production Engineering	1	1

3. NORTHERN IRELAND

Ordinary National Certificates:		
Mechanical Engineering	208	279
Electrical Engineering	157	203

Ordinary National Diplomas:

The first O.N.D. courses started only in 1964.

Higher National Certificates:		
Mechanical Engineering	146	114
Electrical Engineering	85	110
Production Engineering	12	12

Aeronautical Engineering	9	5
Civil Engineering	4	8

Higher National Diplomas:

The first H.N.D. courses started only in 1964.

Appendix 9

NUMBERS OF CANDIDATES, UNITED KINGDOM AND OVERSEAS, TAKING EXAMINATIONS FOR ENGINEERING TECHNICIAN COURSES OF THE CITY AND GUILDS OF LONDON INSTITUTE, 1963 AND 1964

Course No.	Course and Stage	Home		Overseas		Totals	
		1963	1964	1963	1964	1963	1964
293	Mechanical Engineering Technicians'						
	Part I (a)	5762	8174	36	29	5798	8203
	Part II (a)	108	557	-	10	108	567
	Part III (b)	-	10	-	-	-	10
57	Electrical Technicians'						
	Intermediate	1871	2866	96	112	1967	2978
	Final	633	719	-	9	633	728
	Endorsement Subjects .	45	69	-	2	45	71
49	Telecommunication Technicians'						
	Intermediate Level (c)	5800	6500	1700	1950	7500	8450
	Final Level (c) . . .	1800	1650	460	480	2260	2130
300	Supplementary Studies in Telecommunication and Electronics (d)	829	933	267	310	1096	1243
170	Motor Vehicle Technicians' Work	1246	1497	127	179	1373	1676
171	Aeronautical Engineering Practice						
	Part I	336	227	10	7	346	284
	Part II	141	78	2	8	143	86
175	Aircraft Electrical Practice						
	Part I	122	136	2	-	124	136
	Part II	26	28	1	2	27	30
51	Electrical Installation Work						
	Course 'C'	1068	1332	159	227	1227	1559

Notes

(a) Prior to the introduction of the M.E.T. course in 1961, most mechanical engineering technicians took the course in Machine Shop Engineering, No. 63, which is now obsolete. Many colleges had not 'worked out' the former course by 1964 and there were 6779 candidates taking the Final examination in Machine Shop Engineering in that year. In future years, such students will generally be taking the M.E.T. examinations, and the numbers of candidates should greatly increase.

(b) Up to 1964, Part III ofthe M.E.T. course had not generally come into operation.

(c) These figures are estimates of the numbers of candidates taking a 'grouped' examination at each stage, since the official records on which they are based give the numbers of candidates for the examinations in each subject of each course.

(d) These are single-subject entries.

No figures are given for examinations for the Industrial Measurement and Control Technicians' Certificates since the first examinations are being held this year (1965).

Appendix 10

ADDRESSES OF THE PRINCIPAL BODIES CONCERNED WITH EDUCATION AND TRAINING UNDER THE INDUSTRIAL TRAINING ACT

1. The Department of Education and Science,
Curzon Street, London, W.1.
(HYDe Park 7070)

2. The Scottish Education Department,
St. Andrew's House, Edinburgh, 1.
(Edinburgh Waverley 6591)

3. The Northern Ireland Ministry of Education,
Dundonald House, Upper Newtownwards Road,
Belfast, 4.
(Belfast 650111)

4. The City and Guilds of London Institute,
76 Portland Place, London W.1.
(LANgham 3050)

5. The Ministry of Labour,
8 St. James's Square, London S.W.1.
(WHItehall 6200)

6. The Central Training Council,
Ministry of Labour,
8 St. James's Square, London S.W.1.
(WHItehall 6200)

7. The Engineering Industry Training Board,
St. Martin's House
140 Tottenham Court Road, London, W.1
(EUSton 0501)

8. The Construction Industry Training Board,
St. Martin's House,
140 Tottenham Court Road, London, W.1.
(EUSton 0501)

9. The Iron and Steel Industry Training Board,
Steel House,
Tothill Street, London, S.W.1.
(WHItehall 1030)

10. The Wool Industry Training Board,
55 Well Street,
Bradford, Yorkshire.
(Bradford 26493)

11. The Shipbuilding Industry Training Board,
3 St. Andrew's Place,
Regent's Park, London, N.W.1.
(HUNter 4931)

No. 20623
July 1966